WITHIN-INDUSTRY TECHNOLOGICAL SPECIALIZATION, COLLECTIVE ACTION, AND TRADE POLICY

A Dissertation

by

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ABSTRACT

The development of newer and better technologies has reshaped economic markets and will continue to do so in the future. New technologies are widely recognized as a driving force behind economic and political integration. The advent of newer, cheaper telecommunication and transportation methods has eroded social, political and economic barriers between countries. However, little is understood how technological progress has affected market structures and political outcomes–particularly outcomes related to the flow of goods from foreign competitors. This dissertation builds off prior work in many areas. I heavily borrow implications and assumptions from theories of factor mobility, collective action, economies of scale, innovation economics, and international trade. Factor mobility is an important determinant of whether or not actors in my theory care about their smaller group (industry) or their larger group (factor of production). I call the synthesis of these theories "within industry specialization" for the purposes of this dissertation. I argue that fixed costs can be treated as industry specific factor mobility. My idea of within industry specialization is just another type of fixed cost. To measure within industry specialization, I borrow from the economics of innovation. The literature on innovation argues that technological development makes new innovation increasingly harder, in both patents and academia. This means that we can proxy the difficulty/complexity of a field of knowledge by the size of a team necessary to create an innovation as each individual brings a small slice of the knowledge pie. The research question this dissertation ultimately seeks to answer is "when facing foreign competition, why do some industries receive trade protection while others do not?"

DEDICATION

I dedicate this dissertation to every Ph.D student writing their dissertation. Every field requires an ever growing giant we must climb to create new knowledge. While increasingly daunting, with time, hardwork, and good friends the climb is not impossible.

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1. INTRODUCTION

1.1 Motivation

The development of newer and better technologies has reshaped economic markets and will continue to do so in the future. New technologies are widely recognized as a driving force behind economic and political integration. The advent of newer, cheaper telecommunication and transportation methods has eroded social, political and economic barriers between countries. However, little is understood how technological progress has affected market structures and political outcomes–particularly outcomes related to the flow of goods from foreign competitors.

Traditionally, the role of technology has been understood to take two forms. First is to increase productivity/efficiency of producing goods.[1] The second is the reduction of physical barriers to globalization by reducing transaction/transportation costs.[2] Both of these roles increase globalization. Productivity gains increase industry and firm competitiveness versus foreign competitors. While the reduction of transportation and transaction costs increases the number of goods that are in effect tradable across borders that would not be otherwise due to these costs.

In this dissertation I propose a third effect. Technological innovation changes the market structure of specific industries and therefore, the political preferences and motivation for political action. In fact, under certain conditions, technological innovation increases an industry's preference to lobby for protection.

Technological development can have disparate effects on the structure of economic markets through its effects on factor mobility. Typically, technology is seen as something that increases the mobility of capital and labor.[3] However, I argue

[1] Krugman (1994), Grossman and Helpman (1991)
[2] Krugman (1991)
[3] Hiscox (2001)

that technological innovation can also increase complexity of tasks necessitating increased specialization of factors of production. Increased technological complexity, labor for example, must specialize in skills and knowledge that is non-transferable (i.e. industry specific).[4]

Building on prior technology and knowledge, new technologies will have important effects on the structure of industries. Not all industries are created equal; some industries will develop at a more rapid rate while others stagnate (Klevorick et al. 1995; Nelson and Wolff 1997). Not all technologies will have the same effects either. Some technologies increase factor mobility across industries while others, those that have industry specific uses, decrease factor mobility. To get industry specific entry and exit costs, I borrowed from the innovation literature to create a theory of within industry specialization and operationalize patent team size as a measure of this specialization. This not only yields a usable measurement, but offers a theoretical explanation as to the process behind the creation of specialization.

It has been argued that tariffs have decreased in importance with their decline since 1950 (Nenci 2011). Their decline does not diminish the value of studying tariffs in this dissertation. I am seeking to explain heterogeneous tariffs across industries over a long period of time, starting at a time when tariffs were higher than today (or the end of the dataset). While most tariffs have indeed reduced across all industries, the rate of which they have declined varies. The rate of change in tariffs illuminates the relative differences of political power between industries in their ability to influence tariff policy.

Additionally, Tariffs have become lower, but not necessarily less important. Tariffs still affect a number of important economic outcomes such as whether or not an industry survives against foreign competition. If the world price of a good pro-

[4] Jones (2009

duced by an industry is above the world price, a tariff that raises the price of a foreign competitors goods would keep the industry alive. Tariffs are still relatively high in certain sectors and are still a major barrier for developing countries ability to participate in international trade (Hoekman and Nicita 2011). For example, the agricultural tariffs in developed economies harm developing economies more than other types of trade manipulation. Hoekman et al. (2004) estimate that reducing agricultural tariffs by half would improve developing countries welfare by more than reducing subsidies by half in developed economies. This is why much of the focus in recent WTO negotiations focuses on lowering agricultural subsidies (Baldwin 2011, pg. 31; Hoekman et al. 2004). Knowing how technological development and within industry specialization contributes to the rise or fall of tariffs improves policy makers understanding of domestic interests in future negotiations.

Two empirical observations of technology and protectionism are invariably true. First, the world and especially the United States has become increasingly open to international economic exchange. Second, technology has become more complex over time. Arguably at an ever increasing rate. However, the rate of both is not the same for every sector of the economy. Some industries have developed faster than others. At the same time some sectors have liberalized slower than others. Are the two trends related? Is there some plausible causal link between heterogenous technological development? The theory I propose here shows that we already have the foundations for explaining how technology and globalization interact. Building off work in economics and political science on inter-industry factor mobility I argue that heterogeneous growth in technology between industries determines the motivation of actors to act politically in the interests of their respected industry.

This dissertation builds off prior work in many areas. To echo Jones (2009) who cites Sir Isaac Newton when regarding the complexities of knowledge and need for teams in innovation, I stand on the shoulder of these giants to synthesize this dissertation. I heavily borrow implications and assumptions from theories of factor mobility, collective action, economies of scale, innovation economics, and international trade. Factor mobility is an important determinant of whether or not actors in my theory care about their smaller group (industry) or their larger group (factor of production). These are the same assumptions made by many prior researchers trying to explain political coalitions over trade policy (Rogowski 1989, Hiscox 2001).

This ties very closely with work that argues that how narrow a group is (Gilligan 1997) and the particularism of electoral institutions (Kono 2009) are important determinants of actors to overcome collective action problems and receive their preferred trade policy outcome. How "narrow" a group is was determined as the level of intra-industry trade by both Gilligan and Kono. The more diversified the products, the more narrow an actors interests. So narrow in fact, that actors only care about policy that affects one specific product only they produce. I borrow from economics the theories behind economies of scale and fixed costs to both explain why intra-industry trade has this effect and motivate my theoretical contribution of within industry specialization. Simply put, fixed costs change market structures to encourage diversification of product varieties and, therefore, increase intra-industry trade (Krugman 1994). I argue that fixed costs can be treated as industry specific factor mobility. And my idea of within industry specialization is just another type of fixed cost. To measure within industry specialization, I borrow from Jones' (2009) and his various other work on the economics of innovation. Jones argues that technological development makes new innovation increasingly harder, in both patents and academia.[5] This means that we can proxy the difficulty/complexity of a field of

[5] Jones has so far only analyzed patents and academic papers. I believe his theory would apply to other types of group creative activities.

knowledge by the size of a team necessary to create an innovation.

Prior work has examined a number of aspects important to my theory. For example, a lot of work has been done on factor mobility in international political economy (Hiscox 2001; Mukherjee et al. 2009) and a similar related concept called asset specificity in comparative politics (Iversen and Soskice 2001). Often the two literatures are at odds when attempting to explain welfare state spending (Rehm 2009). However, both are important contributions to understanding the ability of an individual factor of production to move from one job to another. The IPE work focuses on mobility between industries while the comparative politics work focuses on mobility between professions. The latter improves on the former by allowing mobility to vary at more micro- levels. The former, IPE, work has only been able to examine the effect of economy-wide factor mobility with variation only by country and time (See for example, Hiscox 2001). This dissertation, therefore, contributes to the extant literature on trade policy by allowing factor mobility to vary by industry. Only one paper to my knowledge has touched how industry varying mobility influences policy outcomes, albeit with a limited scope (Alt et al. 1999).

I employ the aforementioned theories with economic models of international trade to derive preferences over trade policy. To do so, my theory is a synthesis of "new trade theory" (See Krugman 1980; Balassa 1967; Grubel 1970; Kravis 1971; Grossman and Helpman 2002) and classical trade models such as Heckscher-Ohlin and Ricardo-Viner. The link between the two is industry level fixed costs as measured by within industry specialization. The higher the within industry specialization, the closer preferences align with Ricardo-Viner predictions. That is, industry membership matters for determining who wins and loses–i.e. who prefers protection, and who prefers free trade (Heckscher 1919; Ohlin 1933; Samuelson 1948; Rogowski 1989; Hiscox 2001). This combined with my argument that within industry specialization also helps industry actors to overcome collective action problems, I derive a set of conditional hypotheses summarized in Chapter 2 and test these in Chapter 3 and 4.

The research question this dissertation ultimately seeks to answer is "when facing foreign competition, why do some industries receive trade protection while others do not?" The next section outlines my proposed method of attack to answering this question. The goal is that by answering this question I also illuminate the broader theoretical connections of technological progress on market structures, motivations for collective action, and political outcomes.

1.2 Outline of the Dissertation

The rest of this dissertation is organized into four chapters. In Chapter 2, I present the theoretical logic to behind my hypothesis. I propose a theory of within industry specialization which hinges on a new little understood aspect of technological development. That is, technological development not only increases the depth of knowledge, but also the breadth. The theoretical implications from within industry specialization are similar as those from economies of scale. The larger the entry and exit barriers are for a particular industry, the more industry membership matters over other considerations such as factor ownership.

I operationalize within industry specialization as industry-year average patent team size. This measure is employed in the innovation economics literature to measure the complexity of knowledge required to create new innovations.[6] The larger the team, the less each individual must be bringing to the table. Therefore, the field of knowledge must be more complex which necessitates specialization by the factors of production employed in that industry.

I tie this with the logic of collective action and classical trade models to de-

[6]See Jones (2009). Also Wuchty et al. (2007); Jones et al. 2007.

rive an industry's ability and intensity of lobbying over trade policy. The proposed theory helps us understand why certain industries are able to overcome collective action problems to lobbying and successfully receive the trade policy outcomes they prefer. A number of conditional hypotheses are derived interacting within industry specialization and exposure to foreign competition.

Tackling the challenge of testing the predictions of within industry specialization requires two stages with two empirical tests. The natural starting point is to examine whether or not within industry specialization affects collective action behavior. Chapter 3 tests the conditional hypotheses on the intensity of lobbying efforts. Utilizing the data of U.S. patent team sizes, I test the idea that within industry specialization increases industry cohesiveness and intensity to act on an issue. That is, increased specialization leads to greater lobbying efforts by the industry as a whole as actors are "stuck" within that industry. Chapter 4 tests the second stage of my theory–that within industry specialization influences an industry's ability to receive a beneficial trade policy outcome.

Chapter 5 concludes the dissertation with a summary of how the dissertation contributes the extant literature on industries and trade policy. Particularly, I focus on why it is important to study an industry's entry and exit costs to determine the ability of an industry to act as a cohesive political force (overcome collective action problems) and the intensity of that industry's preference. A number of limitations are also discussed with possibilities for future research.

2. OVERCOMING COLLECTIVE ACTION PROBLEMS: WITHIN-INDUSTRY SPECIALIZATION, LOBBYING EFFORTS, AND TRADE BARRIERS

Throughout history technological innovation has created new industries and reshaped old ones. The creation of new ideas, production methods, and technologies has created winners and losers. Particularly, in labor markets where individuals invest in skills relevant to these newly created technologies.[1] At the same time, technology has helped shape and been shaped by increasing globalization in a mutually reinforcing fashion.[2] The effects of these forces on political preferences, powers, and outcomes are understudied and little understood.

As the world has become increasingly globalized, technology has continued to develop. Arguably at an ever increasing rate. However, some industries have developed faster than others. At the same time some sectors of the American economy have liberalized more or less. Are the two trends related? Is there some plausible causal link between heterogenous technological development? The theory I propose here shows that we already have the foundations for explaining how technology and globalization interact. Building off work in economics and political science on inter-industry factor mobility I argue that heterogeneous growth in technology between industries determines the motivation of actors to act politically in the interests of their respected industry. Researchers recognize the need to study inter-industry factor mobility as an important determinant of how an actor's preferences align. However, present research treats the factor mobility of individual industries as homogenous throughout a whole economy, albeit changing through time and across countries. But not across industries.

[1]Acemoglu (2002)
[2]Aggarwal (1999)

For example, building off earlier work by Rogowski (1989), which examined political cleavages given a country's factor endowment ratios, Hiscox (2001) allows factor mobility to vary across time and countries. His arguments that a country with high mobility will reflect class-wide cleavages and those countries with low mobility will reflect industry cleavages draw directly from trade models employed by economists to predict patterns of trade. I examine these models in more detail in section 2.1. Most researchers opt to either assume away mobility by assuming its high (Milner and Kubota 2005), or let the data speak for itself by looking at whether or not industry or class characteristics are significant (Scheve and Slaughter 2001; O'Rourke et al. 2001; Mayda and Rodrik 2005; Imai and Tingley 2012).[3] Mukherjee et al. (2009) and unpublished work by Hiscox and Rickard (2002) do allow factor mobility to vary across countries and time. However, all this work has not allowed factor mobility, in terms of the ability of being able to enter or exit an industry to vary by industries themselves. That is, they assume that there is one single homogenous level of factor mobility for all sectors of an entire economy. Other authors look at the level labor skill generalizability to other industries but with the implication that less generalizable skills lead to higher perceptions of risk. Not in the context of trade policy coalitions and preferences as examined here. This literature is examined in Section 2.3 for its potential use in this dissertation and its limitations.

Unpacking homogenous inter-industry factor mobility to industry specific factor mobility can help us understand why when facing foreign competition, do some industries receive protection from governments while others do not? Consider the following two real world examples. Since the 1990s, the textile industry in the United States is its death throes from increasing foreign competition. The U.S. automobile

[3]This is commonly used also in the compensation hypothesis literature to theorize about who benefits and, therefore, wants compensation policies. See for example Walter (2010)

industry faced similar difficulties in early 1980s and the late 2000s, but has for now survived due to negotiated voluntary export restraints and government bailouts. Both industries at one point were highly competitive and profitable but time and technology transfer eroded away their competitive advantage. Facing stiff foreign competition, why was the textile industry allowed to die out and the automobile industry was not?

The reason one was protected and the other was not cannot simply be to protect jobs. The textile industry employed about 700 thousand individuals in 1990[4] and about 400 thousand in 2008.[5] While the automobile industry employed about 830 thousand in 1990 and about 600 thousand in 2008.[6] Both industries employ relatively large labor forces.

Additionally, it cannot be the lack of productivity or technological improvement. The automobile industry lagged behind its foreign competition and received a bailout estimated to have been around 80 billion dollars in 2008. Many experts agree that this bailout has had a positive effect on the industry's competitiveness evidenced by increased sales and the rapid payback of the industry loans to the government.[7] The textile industry could have also lobbied for government intervention such as trade barriers or bailouts just as the automobile industry did in 2008. In 1969, it was estimated that the textile industry could increase its productivity by investing more than $5 billion dollars, approximately $30 billion 2008 dollars,[8] less than half of the auto bailout. Given that both industries had a lot at stake and motivation for preferring some type of government intervention, why was the textile industry allowed

[4] Mittelhauser (1997)

[5] National Council of Textile Organizations (http://www.ncto.org/industryemployment/index.asp).

[6] U.S. Bureau of Labor Statistics (http://www.bls.gov/)

[7] Hicken (2013)

[8] Given in a speech by John P. Figh of Chase Manhattan Bank to the American Textile Institute. Cited from Mittelhauser (1997).

to die off? I argue that while both industries will prefer government intervention such as trade protection, it is insufficient to just look at the preferences of various economic actors but also the ability of these actors to overcome collective action problems (Alt and Gilligan 1994).

The answer lies with how "stuck" an actor within a particular industry, that is, the factor mobility. This determines the potential losses due to having to readjust to another industry if yours goes under from foreign competition. If an actor can move to another industry and make the same amount of money, why care about the industry? In this dissertation, inter-industry factor mobility can be thought of as the adjustment costs necessary to be paid in order to switch industries. These costs come in two flavors, costs of entry and costs of exit.

The textile and auto industry are used because what I am truly explaining is government policy that favors a particular industry. The empirical chapters will examine actual lobbying for policy and tariffs. Tariffs are just one possible policy that favors an industry as a whole. Both textiles and the auto industry faced competition from foreign manufacturers a number of times in their long histories. This means that they both could have been motivated to lobby the government to do something about it. The choice of policy is not important. The fact that they could or could not get some policy concession is important. I focus on tariffs empirically because it is the most readily available data to test the theory. I focus on other policies (e.g. bailout) in the qualitative discussion to show that it is not tariff I am explaining but favorable policy that the industry itself lobbied for. The interesting question is why did industry X get a policy while industry Y did not get a policy. Maybe in this specific example, policy differences and industry idiosyncrasies matter a lot more than my idea of within industry specialization. This is why I will be explaining the same examples based on tariffs, lobbing, and within industry specialization throughout this dissertation as well. Then generalize even more to empirical hypotheses and tests for all industries.

2.1 Homogenous Factor Mobility

While it is true that both industries want trade protection, the potential losses for the automobile industry may have been higher. One might argue then that these higher potential losses made the automobile industry "lobby harder" for government intervention. However, I argue that this is not necessarily the case. Whether or not factors of production in the automobile industry face any losses depends on their mobility, or readjustment cost, to another industry. If, for example, automobile factories, machines, and skills are easily and cheaply transferred to the production of goods in another profitable industry then the desire to protect the automobile industry is lower. Why would a factor of production care about an industry's profits if it can be easily reemployed elsewhere producing the same profits?

I argue that the factors of production in the automobile industry did not face cheap and easy adjustment. One reason the automobile industry is profitable is due to high start-up costs of entry into the industry. This protects the industry from an influx of competitors but also allows gains due to production at very large volumes. This creates industry specific profits that exist only for those actors employed in that industry. Exiting, therefore, is additionally costly as those industry specific benefits disappear.

In order for there to be anything "specific" to industry specific production, the factors of production must exhibit some level of specialized production techniques and knowledge. Otherwise these techniques and knowledge would spill-over to other industries equalizing their profits. It is safe to assume then that the factors of production employed in the automobile industry exhibit higher levels of automobile industry specific uses. It is true then, that for these factors of production losses would be high due to exit, but it need not be the case. If these factors of production, faced losses due to foreign competition, they would only care about the automobile industry as an important distinction for themselves, if they can only be employed in the automobile industry. If automobile factors of production can move to any other manufacturing industry, they will not care about automobiles as much as manufacturing as a whole. This implies that at different levels of disaggregation of what is an "industry" matters when determining preferences over policy outcomes. The second implication is that the level of mobility that we look at, should match this level of aggregation, otherwise we are making the wrong predictions.

If we use a single economy wide measurement of mobility we can only determine industry vs. class cleavages such as Hiscox's (2001) work. However, we cannot tell, what cleavages would exist in finer grained disaggregation of the economy, such as a specific industry. The same applies within sub-industries within higher level industry classifications. Consider a measurement of mobility for the manufacturing sector and the agricultural sector. We can only tell if manufacturing, overall, is high or low relative to agricultural. From this measurement we cannot tell if the effect of mobility on automobile manufacturing sub-industry has the same effect on the motivations as, say, computer processor manufacturing sub-industry. We need variation, therefore, we need a distinct measurement of both.

Industries are not homogenous; this fact is what distinguishes them as distinct industries to begin with. However, as mentioned in the previous section, some authors either assume complete mobility or immobility to use a particular trade model; and other authors let the data tell them. When authors utilize inter-industry factor mobility in their theories, they conceptualize mobility as the ease of adjustment from one industry into any other industry as a single cross-industry measurement

(See Frieden 1991; Alt and Gilligan 1994; Gilligan 1997; Hiscox 2001, 2002; Hiscox and Rickard 2002; Mukherjee et al. 2009). This is because they derive their theories from the oft cited Hecksher-Ohlin and Ricardo-Viner theories of trade which assume either completely mobile factors of production or completely specific respectively.

2.1.1 Hecksher-Ohlin Model – Completely Mobile

Commonly, to derive trade preferences of actors, researchers utilize the distributional predictions of the aforementioned workhorse models of trade. The Heckscher-Ohlin (HO) model of trade assumes that factors of production are completely mobile within a domestic economy. That is, factors can be costlessly converted from use in one industry to another but are immobile across countries. The original model assumed a "2x2x2" framework (read two by two by two) with two countries, two goods and two factors. Additionally, derived from the HO model, researchers utilize the Stolper-Samuelson theorem (1941). The theorem states that international trade increases real returns for a domestically abundant factor (abundant relative to the rest of the world), international trade decreases returns for factors that are scarce relative to the rest of the world. Factors gain and lose due to the factor price equalization theorem. Because factors of production are immobile across countries, trade is a substitute for cross country mobility. As goods are traded between countries, market forces of supply and demand will equalize the prices of these goods over time. As profits or returns to factors of production are tied to the prices of the goods they are used to produce, some factors "win" and some "lose."[9]

The key theoretical insight from the Heckscher-Ohlin/Stolper-Samuelson framework is the factor price equalization that occurs when factors are mobile across industries. If an industry has higher than average income, competitors from another

[9] For the earliest foundational work, see Heckscher (1919), Ohlin (1933) and Samuelson (1947).

industry will see this and move to this industry equalizing prices between two industries. For economic actors, in this case factors of production, the industry they are employed does not matter for their returns. Just whether or not they are the benefiting factor of production. A well-studied implication is the effect of political cleavages between high-skilled and low-skilled labor in the United States (Scheve and Slaughter 2001). In the United States, for example, high-skilled labor (labor combined with "capital" in the form of human capital) is relatively abundant compared to the rest of the world and low-skilled labor is relatively scarce. Therefore, scholars predict that in the United States, high-skilled labor wins from free trade, while low-skilled labor loses.[10] We can, therefore, expect that an actor that can easily and cheaply adjust to employment to another industry will not be particularly motivated towards protecting the specific industry they are employed in. That is, there is nothing uniquely beneficial towards being in one industry or another.

2.1.2 Ricardo-Viner Model – Completely Immobile

The Ricardo-Viner (RV) model begins with the same underlying economic model of trade as Hecksher-Ohlin but assumes factors of production are "specific" or immobile between industries (Samuelson 1948; Mussa 1982). Factors used in production in one industry cannot be transferred to use in another industry. The economic profits gained from factors of production are, therefore, tied to the industry in which it is employed. In an open economy, industries (and firms) that are able to export due to a competitive advantage (export-oriented) receive an increase in real returns, while those employed in industries unable to compete with their foreign counterparts (import-competing) decreased returns. Under the RV model's predic-

[10]Milner and Kubota (2005) extend this model to the developing country case to argue how democratization in developing countries causes trade liberalization by revealing the preferences of low-skilled labor. In the developing country case, low-skilled labor is abundant and prefers free trade.

tions, political cleavages will form between those who gain and those who lose from trade. Import-competing industries will prefer protectionism while those employed in export-oriented industries will prefer free trade.

These two neoclassical trade models are typically treated as polar opposites and treated studied assuming full mobility or no mobility. Studies assume that either the economy at a given time exists completely as a HO type or RV type and seeks to test implications given one or the other (See Milner and Kubota 2005, Baker 2005, Scheve and Slaughter 2001, Mayda and Rodrik 2005, Mayer 1974). Others have allowed mobility to vary continuously from one extreme to the other (Hiscox 2001, 2002; Ladewig 2006; Mukherjee et al. 2009). The two models are potentially both true where the HO model considered the long-run model and RV being the short-run model. The logic is, that most if not all factors of production given enough time and costs can be repurposed for other industries (Mayer 1974; Neary 1978).[11] These studies, however, ignore that industries are heterogeneous on many important factors, including factor mobility. While a homogenous economy wide level of factor mobility has been successful in explaining many aspects about trade policy, it does not tell us much about industry specific preferences and outcomes as it does not vary from industry to industry.

2.2 Heterogeneous Factor Mobility

Factor mobility can be characterized as the adjustment costs a factor of production must face when entering or exiting an industry in order to be used for other purposes elsewhere. Given the heterogeneous nature of production, each industry potentially has its own entry and exit costs. If this is true, the Heckscher-Ohlin and Ricardo-Viner models are not precise enough for predicting political preferences of

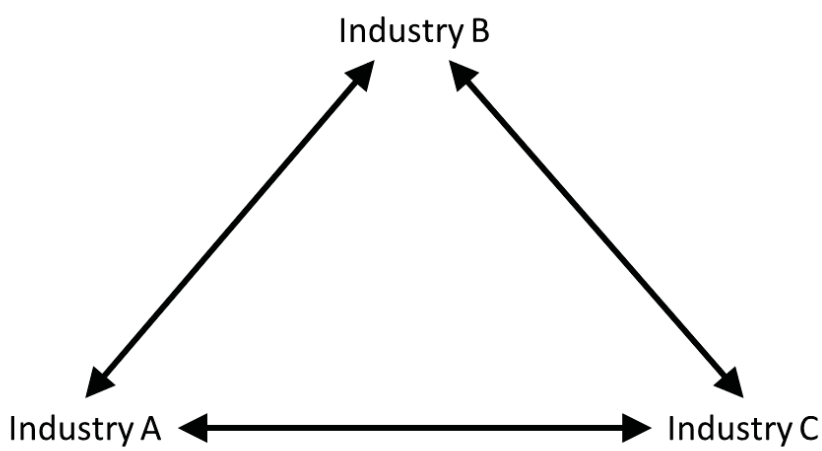
[11] For an application of long-run vs short-run dynamics in trade policy preferences see Mayda and Rodrik (2005).

economic actors. These models only offer predictions based on economy-wide average entry and exit costs. Because these models assume a single estimate of mobility at a given cross-section of the world. Allowing for more disaggregated mobility may help explain the lack of, or weak empirical evidence for either of the two models in recent empirical work highlighted by Mansfield and Mutz (2009). These two authors instead focus on various social-psychological factors (e.g. out-group anxieties, ideology) and sociotropic (caring about the whole economy, and the condition of others) versus the egotropic (caring about one's own economic wellbeing) predictions of trade models.

I choose the industry as the level of analysis to explain protectionism for two reasons. First is that there have been differing rates of protectionism across different industries. The second is that I believe much can be explained based on the logic of collective action. For collective action to occur you naturally need to examine a group of actors with the potential to work together. The industry is such a group of economic actors (firms and their employees) that produce goods considered similar enough to share a common interest in trade policy. The firms and employees themselves could be examined. The latter of which was done by Busch and Reinhardt (2002). However, I believe analyzing the industry is more relevant and interesting to testing theories of collective action of groups. It is easy to believe a firm or employee would act in their self-interest. It is much more difficult to believe that a whole group of firms and employees could come together effectively to lobby for a greater good. This dissertation seeks to determine the factors that influence the ability of these actors to actually do so. Alternatively, factor owners of land, labor or capital could be examined as a common group following a Heckscher-Ohlin framework to draw on theoretical predictions. For the purposes of this dissertation, I stick to examining the implications of collective action theories on the industry and hinge my theoretical predictions on intra-industry trade and Ricardo-Viner models.

Under the neoclassical models, factor mobility is assumed to be equal from any industry into any other industry. For a simple example economy such as in Figure 2.1, assume there are three industries or sectors of production, A, B, and C. Let δ_i denote the cost of moving between industries (immobility), equals either 0 or 1 and where $i = A, B, C$. Let 0 represent "costless mobility" and 1 represent "perfect immobility." Therefore, in the Heckscher-Ohlin and Ricardo-Viner models, $\delta_A = \delta_B = \delta_C$ and all equal either 0 or 1 for perfect extremes of HO and RV respectively. Alternatively, and probably more realistically, readjustment costs range between 0 and 1 and vary over time and space given certain technological, geographic, and/or political factors.[12]

Figure 2.1: Heterogenous Industry Mobility



However, is it reasonable to assume that an industry with low adjustment costs

[12]See for example Hiscox 2001 and Mukherjee et al. 2009

will behave politically the same as one requiring high adjustment costs? Averaging adjustment costs across all sectors like a single homogenous measure of inter-industry factor mobility does not vary across industries. Therefore, it does not tell us anything about industry differences.

2.2.1 Economies of Scale and Fixed Costs to Entry

There are costs associated with industry entry. Bain (1956) defined barriers to entry as "an advantage of established sellers in an industry over potential entrant sellers, which is reflected in the extent to which established sellers can persistently raise their prices above competitive levels without attracting new firms to enter the industry."[13] I extend this definition to also include the entry of labor as well. The logic is that there exists some cost a new entrant must pay in order to participate in an industry. For a firm, this may take the form of fixed costs of investment due to economies of scale. Industries characterized by economies of scale require a firm to produce at very high volumes to be profitable. Therefore, a new potential firm must invest in enough factories, machines, and labor to be able to produce at a large scale. The same can be said of labor. An individual laborer must invest in specific knowledge and skills through education, training, and job experience in order to participate in a particular industry. These are the same investments in human capital that create potential future exit costs.

The profitability of firms also depends on the level of their industry entry barriers (Bain 1956; Scherer 1970; Caves and Porter 1977; Porter 1979) and the persistence of non-competitive rents for firms varies between industries (Waring 1996). The wages of similar workers as well as firm returns can vary significantly across industries

[13] Models of industry heterogeneity and trade policy, "new trade theory," are based on these same arguments of economies of scale and fixed costs (Krugman 1980). See also, Balassa (1965); Grubel (1970); Kravis (1971), Grossman and Helpman (2002), Milner (1997).

with industry membership accounting from seven to thirty percent this variation (Schmalansee 1985; Wernerfelt and Montgomery 1988; Rumelt 1991; Powell 1996).[14] This means that there are still unobserved heterogeneities between industries that are uncontrolled for. The mere fact of being employed specific industry (fixed effect) accounts for at the very least, seven percent of income, controlling for all other determinants of wages such as industry average education and industry profitability. This can be interpreted that for some, there are additional non-competitive rents (or losses) attributed from being employed in an industry outside the benefits attributed to one's own education or productivity. I argue that one of these unobserved industry heterogeneities is industry specific entry and exit costs above the standard barriers to entry already considered in prior research.

While "natural" economic entry barriers may protect firms' ability to extract above competitive rate returns, competition from foreign manufacturers can undermine this natural barrier to entry. Many firms gained these advantages by being the first-mover into the industry when costs of entry were lower. New foreign producers pose a threat because they also entered the industry when costs were low in their respective country. Once they became competitive enough to export, they pose a threat to established domestic producers. Therefore, even industries with high barriers to entry will lobby harder for protection of these industry specific rents.

Gilligan (1997) makes this same argument about industries characterized by high levels of intra-industry trade. Firms within such industries are monopolists of their own specific good. In turn, trade policy applied to them is a private benefit from which they can exclude others. While Gilligan focuses on the intra-industry trade and product variety aspects of his argument, his theory actually hinges on large economies of scale (pg. 549). The theoretical implication drawn here highlights

[14] For a comprehensive survey see Groshen (1991).

that high fixed costs are associated with scale economies. Economies of scale create potential for industries characterized by high intra-industry trade and motivation for political action. It is not, as Gillian argues, that intra-industry trade motivates collective action. It is the classic endogenous variable problem. Fixed costs cause intra-industry trade *and* motivation for collective action, not that intra-industry trade causes motivation for collective action. The same argument can be made of Busch and Reinhardt (2000), who find that the geographic concentration, that is how geographically proximate firms are to one another within an industry, of an industry strongly increases lobbing contributions. For example, Krugman (1991) shows that industries characterized by high fixed costs of production interact with transportation costs to motivate firms to move geographically closer together to gain cost advantages. Fixed costs of production encourage firms to produce in a single location, high transportation costs encourage firms to produce near large markets. This effect, with the added coincidence that transportation costs were high during the industrialization period of the United States, manufacturing is highly geographically concentrated.[15] Again, fixed costs cause geographic concentration *and* motivation for political action and not that geographic concentration causes motivation for political action.

2.2.2 Sunk Costs, Industry Specific Non-Competitive Rents as Exit Costs

There are also costs associated with industry exit. These come in two forms, sunk costs and industry specific non-competitive rents associated with the aforementioned entry costs. Sunk costs come from the initial investment to enter an industry (fixed cost) from investment (industry specific physical capital) and human capital (industry specific skills an knowledge). For labor, these costs and be particularly high.

[15] See Hanson 2001 for a review.

We also know that there exist industry specific income for firms (mentioned above) and labor. Once an individual laborer is displaced from one job and is reemployed in another, their wages are lower and the amount of specialized human capital they have gained in their tenure in the previous industry increases the amount of wages lost (Topel 1990). Workers that change industries when re-employing tend to lose higher portions of their pre-displacement wage (Jacobson et al. 1993) and that those loses too are greater the longer an individual was in their original industry (Neal 1995). This suggests that there is a wage premium for industry specific knowledge on top of general human capital accumulation or that the wage premium arose from non-competitive rents due to formerly high barriers to entry.

As Alt et al. (1996) put it, this income premium is what is at "stake" to be lost when competitors crowd into the industry. The greater the stakes, the greater the potential for collective action. Prospect theory also comes into play because individuals highly value potential losses, increasing the stakes even more (Levy 2003; Tversky and Kahneman 1986). Given this, actors stuck within a particular industry due to high exit costs will be more motivated to act to protect their industry.

2.3 Prior Measurements

A few questions remain. How do we measure industry specific entry and exit costs? And where do industry specific entry and exit costs come from? For the former question, I believe the best approach is to think of entry and exit costs as a combination of fixed costs and potential losses due to exit. In many ways as mentioned above, these are two sides of the same coin. A good measurement should be able to capture these two aspects simultaneously and while also having variations across industries.

Most research approaches the issue of mobility from an economy wide unit of analysis, with variation in either (or both) between countries or across time. Many researchers have approached the issue by leveraging industry and profession classification schemes to measure labor skill transferability. I propose instead to look at fixed costs. Not just any fixed cost but a new form I term "within industry specialization."

2.3.1 Classification Scheme Approach

There are a number of ways in which more disaggregated mobility has been attempted to be measured. These tend to look only at labor mobility and not factor mobility more broadly. First, in the comparative politics literature, Iversen and Soskice (2001) build their "Asset Theory of Social Policy Preferences." They argue that individuals with less portable skills (specific skills/assets) face higher market risks and prefer higher levels of social spending as a safety net. However, Iversen and Soskice's, henceforth I&S, measure is actually a measure of profession specialization not industry specialization because it is derived from the hierarchical structure of the International Standard Classification of Occupations (ISCO-88) which is a classification scheme of occupations or professions, not industries.[16] While ISCO-88 does incorporate industry differences among individual professions, the hierarchy used by I&S to create skill specificity masks these industrial differences. For example, the broader classification of "Machine-operator" has a staggering 480 sub-categories such as ammunition products, drying/laundry, sewing/garments and tire production. It is

[16]This fact is actually noted by the International Labor Organization (ILO) on their website: "For some workers it will therefore be possible to 'predict' the occupation in which they are working with a fairly high degree of success, knowing how they are classified by industry. *This does not mean that ISCO-88 is using industry as a classification criterion* (except in a few cases where it is directly relevant), only that skills in fact are linked to products, materials, etc. which are the determinants of the industry of the establishment in which the work is carried out. The conceptual difference between the two types of classifications should not be forgotten, even though it may be partly obscured by the correlation between them and by the terminology used." Emphasis mine. See `http://www.ilo.org/public/english/bureau/stat/isco/isco88/anc3.htm`.

easy to identify from this the industry the professions belong to–military industrial, dry cleaning (non-tradable), textiles and automobile. I&S's measure assumes all of these professions are of relatively homogenous skills. While this is plausible and useful for many analyses, it does nothing to tell us about industry specific entry and exit, and the potential rents derived thereof. Additionally, the conclusions of I&S's approach, and the whole body of research spun off since, is that higher skill specificity increases risks. This argument is congruent with the one argued here, except I argue increased specialization comes from industry specific skills and knowledge. Economic actors want to protect their industry specific rents, not their profession, at least when it comes to trade politics.

Second, an industry based measure has been adopted utilizing the same logic as I&S but based on the hierarchy of industrial classifications versus professions. For example, Elliot and Lindley (2006) use a three tiered classification scheme where a move from education to manufacturing is an inter-sectoral move. While a move within manufacturing from textiles to furniture is an inter-industry move. And a move from textile weaving to preparation and spinning of textile fibers is an intra-industry move. Where the I&S model lacked industry considerations, the industry classification scheme lacks profession considerations. For example, a janitor working in an automobile plant that goes out of business due to foreign competition can easily find a job in a high school.

Both profession and industry classification schemes do a good job at yielding the empirical expectations the respective theoretical schools they come from. Neither directly tackles other factors of production besides labor. While imperfect, they both have one thing in common, that there is an element of specialization of skills and knowledge required for jobs and that this has important effects on determining the motivations of industry actors.

No classification scheme, however, proposes *where* the need for specialization comes from. That is, why is it that the same profession requires more training or knowledge in one industry than another? The answer is simply the inherent nature of the job or industry. There is something inherent in consumer electronics (vs. textiles) that allows for greater potential in not just technological development but breadth. In the next section I will propose a theory based the inherent nature of some tasks, fields of knowledge/technology and production techniques that leads to heterogeneous breadth of technology. By breadth, I mean that there is greater need and potential for specialization of labor and production techniques. In particular, I explain where specialization comes from and how to measure this abstract "inherent nature." Admittedly, the theory does a better job at explaining the motivations of an accountant in the financial sector potentially switching to an accountant in the airline industry than a janitor switching to an accountant. The latter however, well explained by existing theories of increasing human capital versus industry specific knowledge. Additionally, the goal is to explain how inter-industry adjustment influences political preferences of labor as well as capital, which a profession based approach cannot do.

2.4 New Proposed Measurement

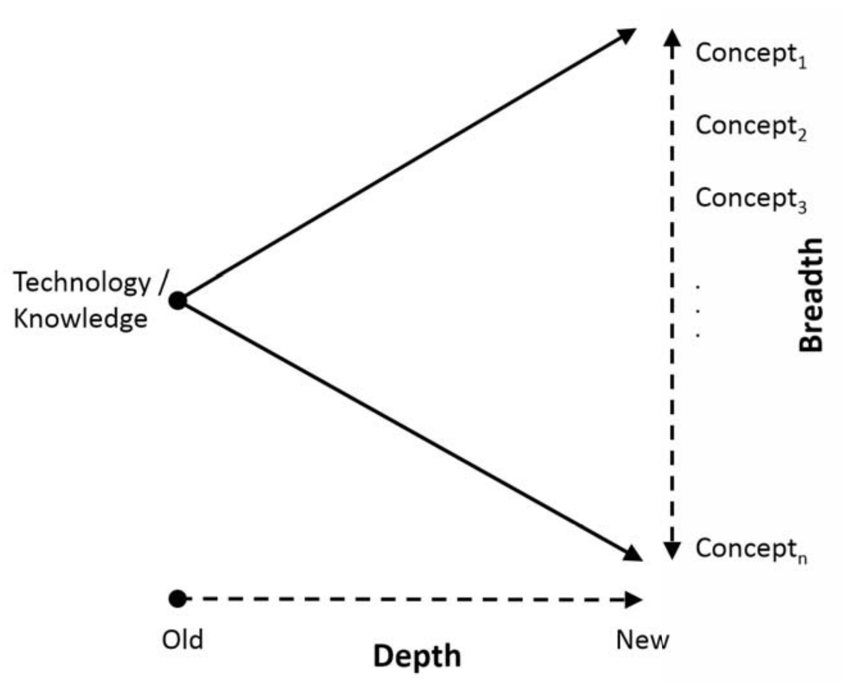
2.4.1 Within Industry Specialization

How do differences of industry specific adjustment costs arise? How can we measure an abstract idea that there is "something inherent" in an industry that necessitates the specialization of knowledge and methods of production? Tracing the history of a technology can be thought of a linear process from simply from old to new. Consider, for example, the development of storage media. Modern technologies based on magnetic (Audio Cassette, Floppy Disk, Hard Disk Platter), optical (CDs, DVDs, Blu-Ray), and solid state (Flash Drives) technologies can be traced back to the same basic logic used in earlier storage mediums. Physical media such as punch cards were invented by Basile Bouchon a textile worker and utilized holes punched into cards in special arrangements to store patterns used by automatic looms. Later in 1890, prior to founding Industrial Business Machines (IBM), Herman Hollerith revolutionized the U.S Census by using punch cards to store and collect data on individuals. He cut the time to compile census information from 8 years to 1 year. The same logic, storing information as a hole or no hole, percolated through newer and newer technologies such as the phonograph (Thomas Edison 1877) and optical compact discs (David Paul Gregg 1962). The most modern widely utilized storage media is the solid state drive, which utilizes special substances and electrical signals to store information in electric charges representing the states of on or off. Whether a tape, spiral, or grid, the same logic behind storing information links all these technologies–storing information essentially in 0s and 1s arranged in some standardized pattern.

One way of analyzing this development would be a linear time line, choosing an arbitrary starting point such as punch cards and ending with solid state drives. Reference the line for depth from old (punch cards) to new (solid state drives) in Figure 2.2. Each successive technology offering some improvement over the last. The body of knowledge storage media technology can have a lot of depth, or stock, in knowledge. A rich history of successive, often incremental, improvements over old technology. Theories utilizing technological development illustrate the process as a one-dimensional forward progression from one level of technology to new more advanced level of technology. Technology takes form as a mechanism that increases efficiency and factor productivity (Posner 1961; Vernon 1966) and decreases transportation costs (Taylor 1951). Investment in technology in the form of Research and

Development (R&D) is seen as a source of comparative advantage (Grossman and Helpman 1991). Alternatively, technology has been characterized as a process which creates new products. Where innovation is the process that creates new products and technology transfer is the process by which new products are transformed into old products. First movers of advanced economies gain monopoly rents as sole producers of new technology products (Krugman 1979; Krugman 1994, pg. 144). Both of these characterizations focus on the incremental nature of technology where newer is better. Neither looks at how technological progress effects the complexity of tasks and knowledge within industries.

Figure 2.2: Depth and Breadth in Technology or Knowledge



An additional way of analyzing the development of technology would be the increasing complexity of the knowledge, inputs and production techniques required to understand, produce and invent them. This would be the vertical line representing breadth in Figure2.2. The combination of depth and breadth makes technological progress into a triangle. With some arbitrary starting point at one end, and a spread out wider end where the width represents a variety of technologies tracing their history back to the original. Newer technology requires not only the knowledge of its own direct history but the various other potentially relevant branches. If one thinks of this as a field of knowledge, or academia, we can think of these as offshoots of earlier more primal fields. As a scholar of international political economy, one must not only know the relevant research in political science but also economics.

Back to the example of storage media, consider Long-play records (LPs) and optical disks such as Compact Discs (CDs) which have many similarities. Both can be used to record information physically on a spiral on a circular disk. While LPs were rather complex in their day, the complexities involved pale in comparison when you consider something more recent like optical discs. A CD requires the production knowledge of specific plastics and metals, lenses and lasers, specialized software to convert digital zeroes and ones to audio, and the speakers themselves. It's not just a matter of counting the number of technologies involved, but the nature and complexity of the technologies themselves. Metals must be designed to store information at a phenomenally tiny scale for long periods of time without decay. Plastics must be blended to withstand massive gravitational forces from the disk's rotational spin. Specialized lenses and lasers as well as sensors must be each crafted specifically for the use of reading the CD. Software must utilize complex mathematical algorithms to convert digital information to analog audio. Each of these component technologies utilized in CDs is in itself more complex than those used in LPs. If we were to trace the complexity of each of these component technologies, we could do so at infinitum. There is something inherently more complex in CDs than LPs, but how can we measure this?

There is a strategy employed in the innovation economics literature by Jones (2009). Jones' work approaches the issue by creating a theoretically derived measurement that proxies for the breadth of knowledge. The logic is as follows. Technological progress has differing effects on different fields of knowledge particular to an industry. All fields become more technologically advanced, but not all fields will become broader at the same rate that they become deep. While all fields progress, some have an intrinsic characteristic that allows them to have a rich broad development. The breadth necessitates specialization and collaboration. This has important effects for industry entry and exit costs. Take labor for example, as technologies become more and more complex, the knowledge required to understand them becomes broader. The average person must invest more and more time into understanding a narrower and narrower subset of a much broader technology (Jones 2009). For example, as political scientists we specialize in a narrow niche of a broader subfield, such as technology and trade politics under trade politics under international political economy under political science. But in order to make new meaningful contributions, we can either learn the wider branches of related knowledge *or* bring in the knowledge of colleagues. The same is true for a software programmer. They would specialize in a particular or subset or programming languages (e.g. Perl, C++, Java) under a broader programming paradigm (e.g. imperative, declarative, object oriented). They would additionally take on knowledge and skills required for programming in a particular industry such as finance and banking or video game design.

This phenomenon has been used to explain the "death of the Renaissance Man" by Jones (2009). He expands on Newton's famous phrase to state that "if one is to stand on the shoulders of giants, one must first climb up their backs, and the greater the body of knowledge, the harder this climb becomes." The argument is that because the body of knowledge has become so great, no single person can become a "Renaissance Man." A commonly used example of a renaissance man or "polymath" and inventor is Benjamin Franklin who worked in the fields of politics, demography, electricity, meteorology, and music among others. While, I do not question Franklin's intellectual prowess, the fact is that all these fields were not as specialized at the time relative as today. It is much easier to make major contributions in young underdeveloped fields. Now, and increasingly so, individuals must either learn more or specialize in the types of tasks they can undertake. Learning more takes more time and effort, while specialization decreases the breadth of individual capabilities. The average individual in technologically complex industries will be highly educated but also more specialized as some will choose to learn more and others to specialize (Jones 2009). We should also expect that in technologically complex industries, individuals are more likely to work in teams given that each individual brings a narrow contribution.

In the innovation literature, is has been found that the complexity of innovations varies across industries; this is conceptualized as the average number of individuals necessary to invent (Jones 2009). To put it another way, the knowledge in some industries is more complex requiring more contributors on each new innovation. The evidence that specialization occurs versus more learning is that the average number of years of education is roughly equal for new innovation. It is the team size and, therefore, complexity that varies. In other words, individuals choose to spend their time in education specializing versus spending more time learning everything. In fields with deep and broad bodies of knowledge individuals must specialize in a narrower body of knowledge. Each individual in these industries brings less to the innovation table and this finding is reflected in the size of teams required to innovate (Jones 2009). Another way this can be interpreted is that a bachelor's degree in economics and kinesiology both require four years of course work, but one potentially has a longer, richer, more diverse and complex body of knowledge and skills.

This team size effect has been observed in both innovation and academic work. Inventions, for example, require different types of technical knowledge and therefore, require the collective work of teams (Jones 2009, Jung and Ejermo 2013). Teams have been found to become increasingly dominant in academic work as well for the same reasons. Wuchty et al. (2007) in *Science* find that over the past five decades, in twenty million papers, teams have become more frequent compared to solo publications across all fields. Additionally they find that team papers are cited more often and this effect has increased over time. Teams of inventors also produce higher quality work and more contributions than their solo counterparts suggesting teamwork multiplies the effect of individual characteristics (Jung and Ejermo 2013). Technological breadth, as measured by patent team size of individual firm's patents, has also been found to be a better predictor of firm performance than total stock–as measured by return to invested capital and sales growth (Moorthy and Polley 2010).

Technological innovation makes the climb to the frontier of knowledge harder because there is a wider body of knowledge and therefore necessitates the need for specialization. Each industry differs in the types and number of tasks its' workers and capital must undertake. Industries with a wide variety of potential tasks will need more specialized workers and production technologies specific to that industry. The ability to perform these tasks will require (re)education of labor and restructuring of capital. This creates entry and exit costs for new competitors entering an industry.

Some industries have grown more and faster with similar amounts of research and development (R&D) spending because of greater opportunities for innovation inherent in their industries which determine the productivity of R&D input (Klevorick et al. 1995; Nelson and Wolff 1997). Additionally the ability to appropriate technology for industry use determines the effectiveness of R&D input (Levin et al. 1987). I argue that technological progress (and opportunities for innovation) further interact with industry specific potential for greater complexity creates an uneven distribution of complexity of tasks between industries. That is the breadth of knowledge and potential tasks necessary to function within an industry varies between industries. Industries with greater need for specialization necessitates individuals to invest in their own human capital to reflect industry specific skills (Jones 2009). Labor and capital within each industry must invest in unique characteristics that increase their marginal productivity within a particular industry but has no effect on productivity in other industries.[17] This creates exit costs when labor and capital seeking to adjust into another industry loses the benefits of their original industry's specific uses. Labor and capital seeking to move into a highly specialized industry will face significant costs to gain industry specific skills and uses. This echoes research that utilizes homogenous factor mobility, finding that technologically advanced economies have less inter-industry mobility because they rely on more intensive use of specific skills and equipment (Hiscox 2002; Hiscox and Rickard 2002).

Following the collaboration, team science and innovation literature (Jones 2009, Ejermo and Jung 2011), I argue that larger patent team sizes on patents reflect the underlying breadth of knowledge necessary for a particular patent to be invented. As the larger the breadth of knowledge is, individuals can either spend more time to learn a broader body of knowledge, or specialize in a narrow field. Broadening one's field tends to be costlier as it takes more time compared to specialization (Jones 2009). Many will opt to specialize and therefore bring less to the innovation.

[17]See Becker (2009[1964]) pg. 40 for an example of general versus specific labor training by firms.

Therefore, if a patent has many collaborators I assume that each individual brought a smaller amount to the table than if the patent had fewer authors. For example, if we observe that patents filed in an industry exhibit many authors systematically over many patents within a particular industry we can be confident that industry is highly specialized.

In the aggregate the patent data shows that the average team size in the United States has increased since 1975 from approximately 1.65 team members per patent to 2.3 team members per patent in 1999. The annual average and maximum team sizes are shown in Figure 2.3 and Figure 2.4 respectively. You can see that while the average may not have increased by a large amount, a minor increase in the average team size has a large effect theoretically. If a field of knowledge moves from primarily solo inventors or authors to necessitating on average two innovators or coauthorship, this is a huge structural change. This is what occurs in patent team sizes in 1986. The median team size increases from one to two in this sample when the average surpasses two team members per patent. Minimum team size has no variation (every year has a minimum of one) and therefore I do not plot it. Figure 2.6 shows the time series of number of patents filed in the United States over the same time period. Figure 2.5 shows the total stock of patents that exist. If my proposition that team size reflects specialization and specialization reflects immobility then it corresponds to work suggesting that within this time period the average level of inter-industry mobility declined (Hiscox 2001; Ladewig 2006; others), arguing a heavier reliance on specialized equipment and knowledge (Hiscox 2002; Hiscox and Rickard 2002).

Figure 2.3: Annual Average Team Sizes

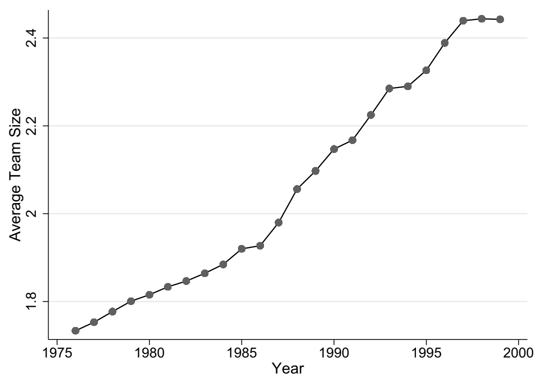


Figure 2.4: Annual Maximum Team Sizes

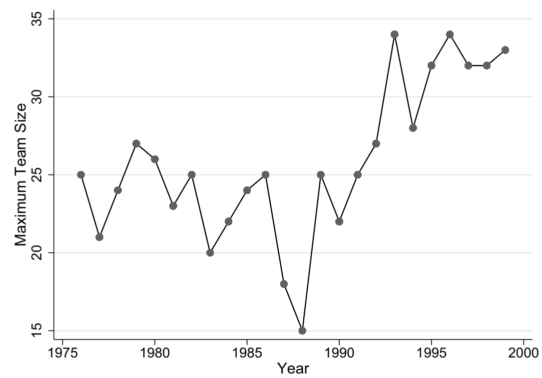


Figure 2.5: Total Stock of Patents

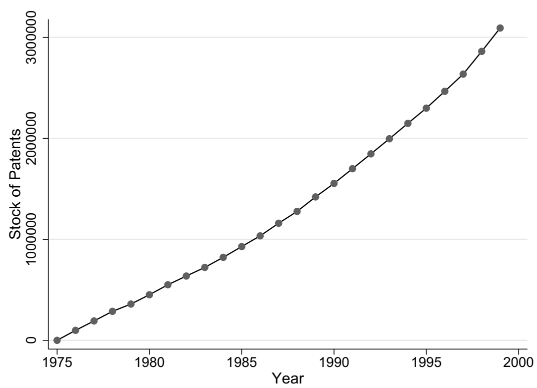
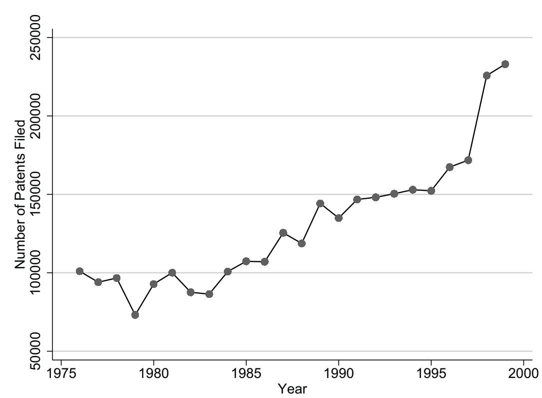
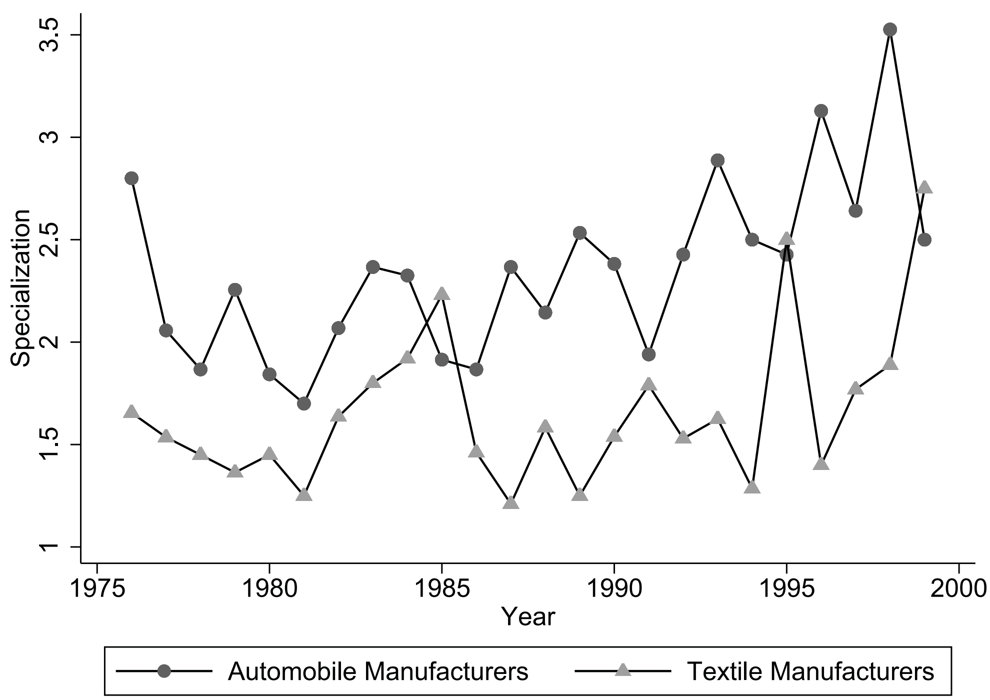


Figure 2.6: Annual Number of Patents Filed



I have used the automobile industry and textiles up until now to motivate my theoretical examples. But how do the team sizes, or the within industry specialization, of both industries compare? Automobile manufacturers are a 4-digit SIC code sub-industry of the 2-digit SIC code corresponding to "Miscellaneous Manufacturing Industries." The Textile time-series was created from the 4-digit code for "Textile Manufacturers," a sub-industry of "Textile Mill Products" more generally. Figure 2.7 shows the annual team sizes for the automobile (SIC87 3711) and textile manufactures (SIC87 2399). As expected from the theory, the team sizes of automobiles is higher than that of textiles. While the difference between the two industries are seemingly small, they are relatively large. Increasing a an industry's average patent team size requirements by one contributor is quite a change. The equivalent in academia would be the difference of working in a field where one can publish mostly solo authored papers to a field where the average publication requires two coauthors. I will examine these two industries in more detail in the concluding chapter.

Figure 2.7: Annual Automobile and Textile Manufacturers Team Sizes



2.5 Within Industry Specialization and Political Mobilization

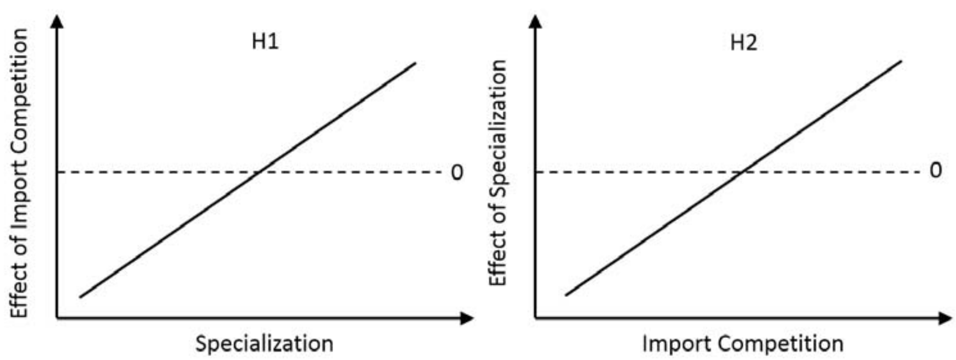
Lobbying the government directly is one way for actor to influence trade policy (Grossman and Helpman 1994). Gawande and Bandyopadhyay (2000) provide an empirical test of the Grossman-Helpman model of government and industry relations. They argue that lobbying spending is an important contributing factor to the level of protection an industry receives.

What can the logic of within industry specialization tell us about the different levels of protection across industries? There is one main implication that flows from the logic of collective action and inter-industry mobility. If an actor is "stuck" within an industry, they will be more likely to care about that industry's overall welfare. Therefore, if within industry specialization reflects an industry's entry and exit costs, we would expect industry's with high specialization to be characterized by higher efforts by actors within the industry to protect it. The reason why, comes from the logic of collective action.

Olson (1965) proposed that smaller groups are more able to overcome collective action problems. The larger the group, the more likely there is free riding and, therefore, under provisioning of a collective good–in this case, policy. A policy that benefits a group is essentially a public good for that group in the sense that it is non-excludable. For a large group, the benefits of lobbying effort will be diffuse among the whole group. The marginal benefit to lobbying effort will be lower given the incentives for free riding. The outcome for a large group, therefore, is a smaller benefit to each actor from lobbying so industry specific lobbying will be low. In fact, a large group also has problems of monitoring the free riding that non-excludability encourages. Consider the lobbying effort of actors within industries. If these actors are less able to switch industries, the effective group size for which cares about a specific policy shrinks. This conjecture about the size of policy beneficiaries draws from the Heckscher-Ohlin and Ricardo-Viner models of trade. If mobility is high, factor price equalization makes industry membership irrelevant for economic benefits. Factor of production will matter with high mobility. Therefore, larger coalitions will be formed than an a coalition of a single industry. This is true, of course, assuming that the total sum of actors across a factor of production is larger than that across a whole industry.

On the other hand, there are entry costs associated with within industry specialization. Entry costs also motivate industry actors to take political action for their own industry. If entry costs are low, potential competitors can crowd into the industry and crowd out non-competitive rents. If protecting the industry is futile, then lobbying for a beneficial policy is unlikely. Consider a firm that is considering lobbying for protectionist policy for its industry, such as textiles. As we know from trade theory, a protectionist policy targeted protecting domestic textile firms will increase income for these firms. While, imports from foreign competitors might decrease, the higher rates of returns will motivate actors to enter the industry. If textiles are an industry with low entry costs, that is, there is low technological within industry specialization, there are little to no barriers preventing competitors from entering the textile industry and eroding away the higher rates of return. This is akin to the Heckscher-Ohlin trade model's expectations of industry specific trade protection. Industry specific returns are eroded away by competitors entering the industry. e argument of group size and stakes comes directly from Olson (1965) on collective action and subsequent work by Gilligan (1997) on intra-industry trade. The larger the group, the more diffuse a benefit is to that group. Therefore it is a balancing act between how large the stakes at hand are, and how large the group is. In my proposed theory, the stakes are partially determined by the entry/exit costs themselves. The greater the entry/exit costs, the greater the stakes because an actor is stuck in a particular group and dependent on that group's wellbeing for their own wellbeing. These same entry/exit costs create the boundaries of a group. The greater the entry/exit costs of a particular industry, the smaller the "group" is relative to a bundle of potential industries one might move into or across your entire factor of production. This is the same dichotomy of group size arguments derived from Ricardo-Viner and Heckscher-Ohlin models of trade. The industry is always smaller than an entire factor of production (or a larger aggregation of the definition of industry boundaries, i.e. motorcycles and automobiles could be grouped into a larger industry called transportation equipment).

Figure 2.8: Hypothesized Marginal Effects on Lobbying



If the textile industry had high levels of technological specialization, creating a "natural" barrier to entry from potential competitors, these gains from trade protection will not be easily crowded out. The implications are similar to the Ricardo-Viner trade model. Industry specific benefits from protection remain with the industry. In this case, policy outcomes fall closer to the private good end of the spectrum than the public good end (Olson 1965). This means that actors within a particular industry derive additional benefits from industry membership. This encourages industry cohesiveness on a particular policy issue. Actors will seek our a policy that benefits their in-group. At this stage I only examine the intensity, that is the cohesive demand of an industry on policy, not yet the preference or direction of lobbying. Therefore, within industry specialization will determine the ability and intensity of preferences of actors to act collectively on a political issue. That is, how motivated they are to contribute to favorable political outcomes. Conditional on the threat to an industry from foreign competition, within industry specialization will determine the level of spending on political lobbying. If within industry specialization is high, industries facing foreign competition will seek to protect their industry (H1). If industry specialization is low, industries will not act as a cohesive unit. The benefits from being employed in a particular industry are low as others can crowd into the industry and current members can cheaply exit. Therefore, in this case I expect increases in import competition to decrease lobbying effort relative to the high specialization group (H1). Additionally, for industries with high import penetration, increasing specialization will increase the motivation of industries to act as a cohesive unit and increase costs associated to exit. These industries will spend more on lobbying to protect themselves (H2). Last, those industries with low import penetration, increasing specialization will have a negative effect on political lobbying. These groups face little challengers from abroad and are also protected by the entry barriers created from within industry specialization (H2). To summarize, the hypothesis derived are visualized in Figure 2.8 and written as:

Hypothesis 1 *In industries with high (low) within industry specialization, increasing import competition has a positive (negative) effect on political lobbying.*

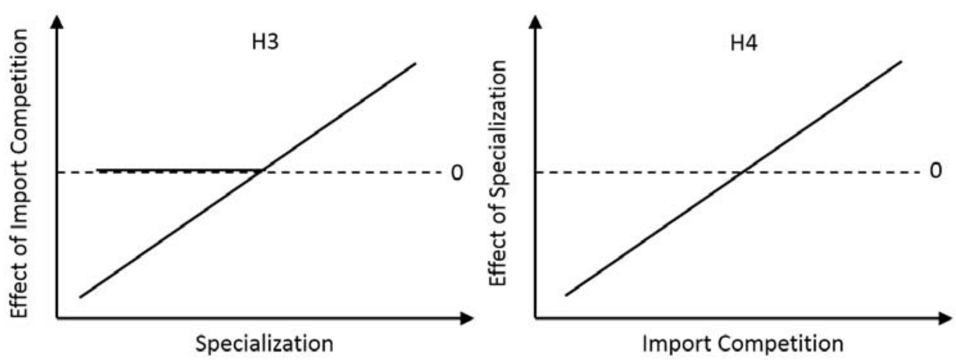
Hypothesis 2 *In industries with high (low) import penetration, increasing specialization has a positive (negative) effect on political lobbying.*

2.6 Within Industry Specialization and Trade Policy Outcomes

While my theory has many implications drawn from Ricardo-Viner versus Heckscher-Ohlin framework, it is actually a synthesis of intra-industry trade theory. In my theory, fixed costs associated with economies of scale create theoretical conclusions that mimic those of the Ricardo-Viner model. The higher the costs to entry into an industry, the more the specific industry behaves as if it were in a Ricardo-Viner – that is, zero or low factor mobility – type of economy. This is slightly different from the traditional Ricardo-Viner/Heckscher-Ohlin approach where all industries in an economy are treated as having a single level of factor mobility. Unpacking the blackbox of "factor mobility" into industry specific "mobilities" is a natural extension into intra-industry trade models based on economies of scale and fixed costs. Existing work has posited that increasing returns to scale drive a country's politics towards regional economic integration (Milner 1997). While my theory does not directly address regional integration, it does illuminate some additional insight to the idiosyncracies addressed by Milner (1997). For example, she concludes that firms with economies of scale may benefit more from regional integration than global integration. Similarly, as within industry specialization behaves similarly, probably as a compliment to standard fixed costs, those firms in industries with high within industry specialization may be pushing for reduced barriers through regional integration. Currently, I examine only overall lobbying and tariff levels and do not distinguish between those specific to regional agreements.

To determine whether industries receive the trade policy they prefer, we need to first derive their preference for either protection or free trade. First, using the Heckscher-Ohlin and Ricardo-Viner framework we can determine whether trade policy will be along industry lines or not. If an industry is characterized by high within industry specialization, we effectively have a Ricardo-Viner derived preference. Industry actors stuck in their industry will want to protect it. If an industry has low within industry specialization, we have Heckscher-Ohlin type preferences. Actors will not care about their industry of employment because they can either cheaply move to another industry or they do not really derive any industry specific rents because of competitors entering the industry.

Figure 2.9: Hypothesized Marginal Effects on Trade Barriers



I derive four conditional hypotheses for the interaction of within industry specialization and import competition. These conditional hypotheses are summarized in Figure 2.9, where the left diagram gives the hypothesized effects of import competition given levels of specialization. The dark lines represent the hypothesized marginal effects of specialization and import penetration respectively. If the line is above the zero (no effect) cutoff, I expect that variable to have a positive effect on trade barriers. If it is below, then I expect the variable to have a negative effect. There are four possible combinations of the specialization and import penetration interaction with five theoretical implications. It is important to emphasize that both protection (at least as a tariff) has declined over time and technology has become more complex over time. What I am really talking about when I say an industry will increase its level of lobbying or have higher tariff rates is that the relative rate of change between industries will be different. The theory and empirical models approaches this from a long run equilibrium framework, that at any given time the levels will be higher/lower for a specific industry. But again, in reality it is that over time certain industries had slower reduction in protection.

First, as specialization increases to a level high enough to create sufficiently high entry/exit costs as to motivate actors to overcome collective action problems, the expected effect of increasing import competition to be positive (H3). Second, low specialization industries are unable to overcome collective action problems, face potential entrants due to crowding, and face little costs to exit. These are the industries that have their preferences washed out at the negotiation table. There are two alternative hypotheses for the low within industry specialization case. Either industries will be completely unable to receive protection because they do not lobby hard enough (H3), or they will be "thrown under the bus" as concessions for reciprocal trade policy negotiations (H3).

Third, when import competition is high then increasing specialization would increase what is at stake for your particular industry. These actors are stuck in their industry and face foreign competitors. Not only do actors face high costs from foreign competition but also from exiting the industry (H4). Fourth, if import competition is low, I expect to observe that increasing specialization will decrease barriers (H4). These industries do not need or seek protection. Increasing specialization would have the effect of allowing them to overcome collective action problems and lobby for reciprocal reductions abroad. Or alternatively, it is possible that at low levels of import competition, specialization actually has a moderate protection effect where the need for trade barriers are offset by entry costs into the particular industry. These would effectively be protecting industries from potential competitors crowding into the industry. Again, negating the preference for high trade barriers. The hypotheses are summarized as:

Hypothesis 3 *In industries with high (low) within industry specialization, increasing import competition has a positive (no / negative) effect on trade barriers.*

Hypothesis 4 *In industries with high (low) import penetration, increasing specialization has a positive (negative) effect on trade barriers.*

As a preliminary look into the hypotheses I examine the population of industries within a two-by-two table. Table 2.1 is a crosstabulation with high and low import penetration on the horizontal axis and within industry specialization on the vertical axis. High and low were determined by examining the distribution of the two variables. This scatterplot is the basis for an empirical robustness test based on the idea that the theory should most strongly predict the extremes at the very least. This figure is 4.15 in Chapter 4. The high and low cutoff point for import penetration is at the 90th percentile where the top ten percent of industries with highest rates of import penetration are labeled as high. The cutoff point for within industry specialization was similarly chosen as one and a half team members. Industries with greater than one and a half patent team members on average were coded as high.

Examining the table illuminates a number of initial patterns that support my arguments. First, I included the average tariff rate for each quadrant. Given the theory, I would expect those with high import penetration and high within industry specialization to have the highest tariff rates. While, low/high and high/low are close in tariff magnitude the high/high quadrant is indeed higher. This finding is merely preliminary and will be examined with greater empirical rigor in Chapter 4. The last thing of note in this table is the list of example industries in each quadrant. I selected the industries by ranking them by how often they came up in each category. These then were added in alphabetically, in no particular order on additional variables other than their frequency in each category. On face value, each group seems to fit in each category based on my theory. For example, the low within industry specialization industries are less technologically complex industries such as broadwoven fabric mills and pottery products. Also, those industries with low or high import penetration correspond to those one might think are heavily imported or not. For example, high import penetration includes toys, clothing, and computer equipment. While low import penetration includes those that make more sense to be produced domestically such as sheet metal work (not sheet metal itself), dental supplies, and small arms/munitions. In the next chapter I examine lobbying expenditure based on these categorizations in a fully interactive model and follow up with a chapter on tariff rates themselves.

Table 2.1: Within Industry Specialization by Import Penetration

	Import Penetration		
Within Industry Specialization	Low	High	Total
Low	2927 $t = 0.045$ Abrasive Products Broadwoven Fabric Mills Canvas and Related Sheet Metal Work Wood Products	620 $t = 0.052$ Dolls and Stuffed Toys Musical Instruments Textile Machinery Waterproof Overgarments Pottery Products	3547
High	2944 $t = 0.053$ Dental Equipment and Supplies Industrial Gasses Industrial Machinery Measure and Control Devices Small Arms and Munitions	1099 $t = 0.057$ Calculating and Accounting Equipment Computer Equipment Audio and Video Equipment Machine Tools, Metal Cutting Printed Semiconductors and Related	4043
Total	5871	1719	7590

3. HETEROGENOUS WITHIN-INDUSTRY SPECIALIZATION, COLLECTIVE ACTION, AND INDUSTRY LEVEL LOBBYING

In this chapter, I present the first empirical test of the theoretical implications of within industry specialization. Before looking at actual policy outcomes, I examine the intensity of industry lobbing. Differing lobbying levels are an antecedent observable implication of the theory proposed in the previous chapter. I would like to see whether or not actors care more about industry membership when specialization is high. I argue that the results here show that this is indeed the case. Controlling for a variety of factors that could contribute to lobbying expenditures, industries with higher levels of within industry specialization on average spend more on lobbying.

To summarize; I assume actors within an industry are rational and care about increasing (or maintaining) their own economic well-being. The theoretical unit of analysis, the actor, is simply a single owner of a factor of production such as land, labor, or capital. I focus primarily on labor, and to an extent capital, as examples of specialized uses and tasks are easier to examine. I also derive these actor's preferences from the two classical trade models, Heckscher-Ohlin and Ricardo-Viner. That is, do factor owners care about which of the three factors they own (HO) or do they care about which industry they employ the factor (RV)? This is going to be determined by how costly it is to move from one industry to another. To put this very simply: (1) If you can't leave your industry, you will care about the industry's health. (2) If your factor is making you extra money just because it's in your industry, you will care about the industry's health. Next, the level you care about industry membership or factor ownership is going to interact with how much foreign competition you face to determine your intensity of lobbying. This is what I empirically examine in this chapter. If actors stuck within industries tend to lobby more intensively, we should also expect them to be more likely to actually receive the policy outcome they prefer. In Chapter 4, I examine the actual policy outcomes using this exact same logic.

3.1 Research Design

The variables used in this dissertation span overs 385 U.S. industries at the 4-digit SIC87 level spanning from 1976 to 2013.[1] In this chapter, I examine the level of industry effort towards changing policy. A number of factors reduce the number of usable observations in this chapter. Data limitations are discussed in the discussion below. The dependent variable, industry-year average spending on political contributions, varies across industries and time as a response to many heterogenous industry and temporal characteristics. Table 3.1 contains the full summary statistics of the raw, full sample data for all the variables used to compile the data in this analysis. This data is used for both the analysis in this chapter and Chapter 5. Table 3.2 summarizes the cross-correlations of the same raw variables.

[1] This corresponds to 20 industries at the 2-digit SIC87 level. Summarized in Appendix A.

Table 3.1: Full Sample Summary Statistics

Variable		Obs	Mean	Std. Dev.	Min	Max
4-digit SIC87 Industries	i	23,378	$\mathrm{i}_{full} = 950$		$\mathrm{i}_{estimation} = 385$	
Year	t	23,322	$\mathrm{t}_{full} = 25$		$\mathrm{t}_{estimation} = 25$	
Annual Number of Patents	n_t	19,325	161,483	65,542.44	73,122	283,536
SIC-Year Number of Patents	n_{it}	19,325	249.36	2,936.63	1	126,946
Annual Average Patent Team Size	a_t	14,574	2.07	0.24	1.73	2.44
Number of Teammembers per Patent	$count_p$	2,067,313	2.023	1.43	1	34
SIC-Year Average Patent Team Size	S_{it}	14,574	1.89	0.92	1	16
Import Penetration	P_{it}	14,193	0.60	0.26	0	1
Customs Value of Imports	$Imports_{it}$	14,341	14.18	75.15	0	2,750.56
Export Value	$Exports_{it}$	14,327	5.69	16.02	0	337.24
Ad Valorem Tariff Rate	D_{it}	10,018	0.05	0.06	0	0.68
Lobbying Expenditures	L_{it}	4600	5844307	$1.27e+07$	0	$1.85e+08$
Intra-Industry Trade	IIT_{it}	14,193	0.51	0.28	0	1
Total Factor Productivity	$TFP5_{it}$	21,955	0.98	0.590	0.045	38.44
ΔTFP	$\Delta TFP5_{it}$	21,496	0.004	0.065	-0.641	0.90
Trade Costs (Transport+Insurance)	$Costs_{it}$	10,018	0.06	0.045	0	1.40
Employment (in thousands)	Emp_{it}	21,955	37.61	52.25	0.40	565.40
Payroll (in millions)	Pay_{it}	21,955	725.49	1,389.85	5	22,245.30
Capital Expenditures (in millions)	Cap_{it}	21,955	151.96	457.46	0	14,583.60

Note: "Full" is limited to where the independent variable, S_{it}, was available.

Table 3.2: Cross-Correlation Table

Variables	n_t	n_{it}	a_t	S_{it}	P_{it}	$Exports_{it}$	IIT_{it}	$TFP5_{it}$	$\Delta TFP5_{it}$	D_{it}	Emp_{it}	Pay_{it}	Cap_{it}	$Costs_{it}$
n_t	1.00													
n_{it}	0.03	1.00												
a_t	0.92	0.02	1.00											
S_{it}	0.18	0.02	0.19	1.00										
P_{it}	0.76	0.03	0.58	0.12	1.00									
$Exports_{it}$	0.18	0.04	0.21	0.06	0.18	1.00								
IIT_{it}	-0.06	0.06	0.00	0.02	-0.12	0.13	1.00							
$TFP5_{it}$	0.05	0.00	0.16	0.04	0.10	0.41	0.03	1.00						
$\Delta TFP5_{it}$	-0.09	-0.02	-0.06	-0.00	-0.09	0.07	0.01	0.10	1.00					
D_{it}	-0.27	-0.03	-0.28	-0.09	-0.09	-0.17	-0.19	-0.08	0.01	1.00				
Emp_{it}	-0.05	0.12	-0.02	-0.02	-0.07	0.39	0.10	0.05	0.01	-0.06	1.00			
Pay_{it}	0.13	0.11	0.15	0.03	0.05	0.63	0.11	0.15	0.00	-0.18	0.78	1.00		
Cap_{it}	0.08	0.02	0.05	0.05	0.02	0.59	0.06	0.26	0.02	-0.16	0.60	0.70	1.00	
$Costs_{it}$	-0.16	-0.10	-0.18	-0.02	-0.18	-0.19	-0.16	-0.07	-0.01	0.17	-0.08	-0.15	-0.03	1.00

3.2 Dependent and Independent Variables

3.2.1 Industry Lobbying Expenditures

The dependent variable of interest here is collective action efforts, i.e., the total effort an industry expends on influencing politics. Prior work has utilized lobbying expenditures and political involvement of employees to operationalize collective action (Busch and Reinhardt 2000). I take a similar approach by utilizing data from the Center for Responsive Politics.[2] Other studies have utilized complaints logged with the International Trade Commission (Gilligan 1997) and debates in the U.S congress (Hiscox 2001). For the analysis in this dissertation I focus on lobbying expenditures. The raw lobbying data has its own industry coding scheme, this was matched with SIC-87 4-digit codes to merge with the patent, trade, and industry data.

The distribution of spending is concentrated near 0 with 214 industry-years with zero spending. Figure 3.1 summarizes the frequency distribution of the whole variable.[3] Ten percent of industry-years have spending less than \$50,000. Half of the industry-years have spending of more than \$1.3 million and a whole quarter have spending over \$5 million. The largest spenders are spending over \$100 million a year! For example the top 5 industries in 2011 spent \$241 million (pharmaceuticals), \$158 million (insurance), \$150 million (oil and gas), \$145 million (electric utilities, non-tradable), and \$126 million (computers). Spending is of course sensitive to the economic climate. For example, the number of lobbyists and total spending of the automobile industry drastically increased around the 2008 crisis and fell shortly after. This type of behavior is exactly what I am trying to explain in this chapter. Figure 3.2 displays the annual box plots for lobbying expenditures for the whole time

[2]The data set was downloaded from `http://www.opensecrets.org/lobby/`. A bulk data set download is available by creating a free account with the Center.

[3]Taking the log of lobbying to control for industry size did not drastically change the results. I additionally rely on other control variables to take account of industry size.

period available.

Figure 3.1: Distribution of Lobbying Expenditures

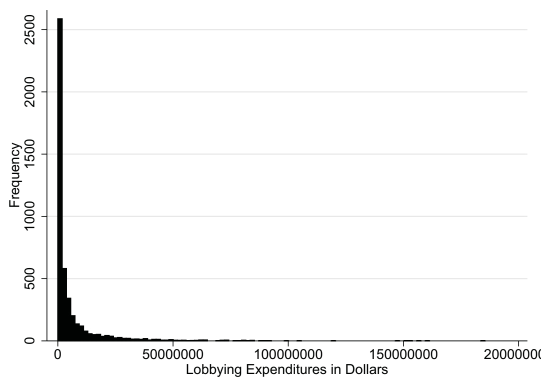
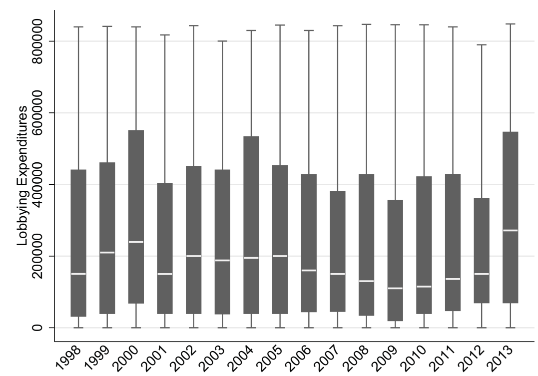


Figure 3.2: Box Plots of Lobbying Expenditures over Time



The variable itself, L_{it}, was constructed for each industry-year by summing firm level lobbying to create industry totals with exactly 4600 potentially usable observations spanning 223 industries from 1998 to 2013. Given the scaling of the variable, I take the natural log of the lobbying expenditures to normalize the data and adjust for industry scale issues.[4] However, because the rest of the data spans from 1975 to 1999, the analysis in this chapter is limited to two years. This, combined with listwise deletion ultimately reduces the usable observations to about 332 industry-years. The shape of the distribution and summary statistics changed very little when losing these observations.[5]

[4]Industries with confirmed zero spending on lobbying are treated as 0.0001 and then logged. Otherwise they would drop out as you cannot take the natural log of zero.

[5]I assume that the observations lost due to merging are missing at random. There is no reason to believe there is a relationship (selection bias) between why they are missing and any of my variables.

3.2.2 Within Industry Specialization

Industry specific *within industry specialization* is measured as an industry's average patent inventor team size per year. The data come from the US Patent Office and were compiled by Hall, Jaffe and Trajtenberg (2001).[6] The updated version of the dataset contains information on over 3 million patents from 1963 to 2006. Ultimately, this data is limited to just under 3 million patents from 1975-1999 due to lack of available information on counts of patent team members. The data on individual team members were collapsed on the patents they are cited on to create counts of the number of inventor, $count_p$, per patent, p. Additionally, a count of patents per industry, i and year, t, was created to compute the averages and is denoted as n_{it}. These were matched using updated patent data that contained patent to 4-digit SIC concordances to create team size averages, S_{it} per 4-digit SIC87 industry year.[7] These were calculated as $S_{it} = \frac{\sum_{i=1}^{n} count_{pit}}{n_{it}}$. For comparison, the national economy-wide average was also computed for the economy as a whole as $a_t = \frac{\sum_{i=1}^{n} count_{pt}}{n_t}$. To ensure that the measurements capture as much information as possible all averages were compiled from the original whole patent dataset and not a trimmed version limited by availability of other variables. This was then aggregated to create a 10-year running average.

Patent data does have its limitations. Patents by nature are a voluntary disclosure of information in return for temporary legal rights to their use guaranteed by the government. Not all inventors, individuals or firms, want to disclose the information given alternatives such as secrecy. Additionally, not all patents meet the criteria set by the U.S. Patent and Trademark Office as novel, non-trial, and having a commercial

[6] The data is available on the NBER website at `http://www.nber.org/patents/`.

[7] The updated data is available either by linking from the aforementioned NBER website or directly at `https://sites.google.com/site/patentdataproject/Home`.

application (Hall et al. 2001, pg 4). However, unless the will or need to disclose information through patents is correlated with the complexity of the patent (i.e. team size), these limitations should not be a problem in this analysis.

3.2.3 Industry Import Competition

Import competition is a key determinant of the political preferences of industries over trade policy. Where the level of Intra-Industry trade (Gilligan 1997), electoral institutions (Kono 2009) and within industry specialization (argued here) determine the ability for economic interests to lobby and gain protection, import competition determines the nature of economic preferences. But, for the purposes of the analysis in this chapter, import competition is utilized to proxy for intensity of harm actors within an industry face not the direction of preference for or against protection. Industries facing import competition that lose income due to cheaper foreign imports will lobby more intensely. Industries facing little competition are conversely, less likely to lobby as intensely. Whether or not these industries lobby will be conditional on overcoming collective action problems (Gilligan 1997). The ability to overcome collective action problems being determined by the level of industry specific entry/exit costs as measured by within industry specialization. The level of *import competition* is operationalized as the total value of $imports_{it}$ for each industry i at year t. The data for this variable is taken from Bernard, Jensen, and Schott (2006).

3.2.4 Controls

Intra-Industry Trade Some work has examined the effects of intra-industry trade on collective action and trade barriers. Gilligan (1997) for example argues that firms involved in intra-industry trade are effectively monopolists in the good they produce, thus lobbying for policy is a private good and collective action problems disappear (pg 464) and industries will lobby for protection.[8] To account for potential effects of intra-industry trade, I control for it utilizing a commonly employed measure of Intra-Industry trade, the Grubel-Lloyed index (Grubel and Lloyed 1975). It is calculated as $IIT_{it} = 1 - \frac{|Exports_{it} - Imports_{it}|}{Exports_{it} + Imports_{it}}$ and ranges from 0 (no intra-industry trade) to 1 (all trade is intra-industry). A modified version of this was also calculated as $IITm_{it} = \frac{Exports_{it} - Imports_{it}}{Exports_{it} + Imports_{it}}$ which "unwraps" the standard Grubel-Lloyed index so that a value of -1 denotes only exports, 0 is only intra-industry trade, and 1 is only imports. This version is used in the robustness checks in Chapter 4.

Trade Costs A measure of trade costs from Schott (2008) is included as a control for each industry year and denoted as $Costs_{it}$. These are calculated as transportation costs plus the cost of insuring shipments. Trade costs are an important factor in international trade. For example, in gravity models, distance between two economies proxies for transportation costs. Trade costs play an important role in determining which goods get exported/imported through their effect on local comparative advantage. While a country may be comparatively advantaged in producing a particular good, high transportation costs may make it too expensive to export. The logic is that it may be cheaper to produce in the comparatively advantaged country, but the production cost plus transportation costs exceeds the price at which the good could be sold in the foreign market and therefore, will not be exported/imported (Schott 2008).

Total Factor Productivity To control for the productivity of an industry a measure of total factor productivity is included and denoted as $TFP5_{it}$. Productivity is an important determinant of which firms will export when exposed to international markets, which will produce only for domestic markets, and which will exit or die out

[8] See also Kono (2006) for an extension with electoral institutions coming into play. He argues that intra-industry trade leads to protection only when electoral institutions favor narrow interests.

(Melitz 2003). While the data examined here are not at the firm level, at the industry level we would expect higher productivity to be correlated with the existence of a larger number of productive firms. This measure is based on five factors of production: non-production workers (number of), production workers (worker hours), energy (real expenditures), materials (real non-energy expenditures), and capital (real value total stock). The annual change in total factor productivity is also included. The data is from the Becker et al.'s (2013[1996]) NBER-CES Manufacturing Industry Database[9]

Industry Size To control for industry size and importance in both the economy and in politics, three variables are included. The first are total employment in thousands of workers, Emp_{it}, and total payroll paid to these workers in millions, Pay_{it}. The third is investment, or capital expenditures, in millions of dollars and denoted as Cap_{it}. This data is also from the Becker et al.'s (2013[1996]) NBER-CES Manufacturing Industry Database. Industry size, particularly the size of employment, may be a good way to measure potential for collective action. The logic being that smaller groups are more likely to overcome collective action problems given that any benefits from trade policy will be more concentrated and a higher potential for excludability (Alt and Gilligan 1994).

3.3 Methodology and Results

The dependent variable for all models is the *total industry spending on political contributions*, L_{it}. The are two primary independent variables of interest included in all models. The first is *specialization*, S_{it}, as measured by the 4-digit SIC industry average patent team size. The second variable is represents *import competition*, $imports_{it}$, and is measured as total value of imports. A number of controls discussed

[9]The data covers 459 4-digit SIC87 industries over 52 years. This data is available at `http://www.nber.org/data/nberces5809.html`.

above are included.

3.3.1 Diagnostics

Clustered standard errors were used for each industry. Residuals plotted against fitted values from Model 1 and 2 without fixed effects displayed minor levels of heteroscedasticity. A likelihood ratio test was conducted to test for panel heteroscedasticity by estimating the model using an iterated generalized least square estimator taking into account panel heteroscedasticity and one that did not.[10] The results of the likelihood ratio test favor taking into account panel heteroscedasticity. Hausman tests for fixed effects versus random effects reject the null hypothesis that the models yield comparable coefficient estimates. Therefore, the random effects model is rejected over the fixed effects model. However, due to data limitations caused by listwise deletion in Model 3, all final models were estimated without fixed effects. There are more industries at the 4-digit SIC87 level than observations because of limited overlap between the lobbying and industry data sets. Fixed effects at the 2-digit SIC87 level did not change the results much either, but did marginally reduce significance of the IVs. Additionally, because of the limited number of years, just two, I also controlled for year fixed effects. The year fixed effect was not significant, nor had any effect on the results in any of the models and is therefore left out. The results from the models without fixed effects are shown below.

Because of the time series concerns inherent in the structure of the data, panel data unit root and autocorrelation were conducted. The panels were fairly unbalanced, therefore, Fisher-type (Choi 2001) tests were conducted which allow for un-

[10] I assume that panels are not correlated with each other. There is no reason to believe they should be so from the theory. The level of within industry specialization in one industry should have no effect on another. Unless, somehow, industries compete with each other on innovation complexity. It is more plausible that if there is competition, it is among firms within the same industry (either domestically or with foreign competitors).

balanced panels. Both both Augmented-Dicky-Fuller and Phillips-Perron versions of the test were conducted on the primary dependent (lobbying expenditure) and independent variables (specialization and import competition). The Fisher-type test performs a unit-root test on each panel separately and then combines the p-values to create an overall test statistic for whether or not the panel data contains a unit root. These tests rejected the null hypothesis that all panels contained a unit root for all three variables. Additionally, an appropriate test for panel data serial autocorrelation was conducted on the same three variables and failed to reject the null hypothesis of no autocorrelation (Wooldridge 2002; Drukker 2003). Again, the final models only span two years. Using a year dummy had no effect on results.

The distribution of the patent team size variable shows a decline in density towards values above three team members per patent. This raises the concern that these higher values might be outliers. Additionally, there might be other outlying cases not immediately obvious, therefore I test for multivariate outliers that may be potentially driving my results. To test for multivariate outliers I calculated Cook's distances from the full model. Two observations have Cook's distances near, but still under, a value of one–the standard cut off value for a multivariate outlier with high influence (Cook 1977; Cook 1979; Cook and Weisberg 1982). The two observations were Malt Beverages in 1999 (SIC87 - 2082), Candy and other Confectionary Products in 1999 (SIC87 - 2064). Both of these have relatively large levels of spending on lobbying ($> \$1mil$), above average patent team sizes (> 2), relatively low import penetration (< 0.1) and moderate levels of intra-industry trade (~ 0.5). Removing these had very marginal changes to the estimated coefficients and standard errors.

3.3.2 Results

Table 4.1 summarizes the regression results for the three models. The first model contains only the main effects specialization and import competition, both of which are positive as I would expect but they are not statistically significant. This is not too much a concern as the theory predicted is conditional on the interaction between specialization and import competition. The second model contains the main effects, plus the interaction term between them. Here we see that the main effect for import penetration and the interaction are significant. And the final model adds the series of controls mentioned above. As the marginal effects of the main effects and interaction term depend on the variances and covariances of each other, the coefficients for these terms are not directly interpretable (Brambor et al. 2006; Berry et al. 2012; Aiken and West 1991). Therefore, marginal effects were calculated for specialization and import competition based on the values of the other. The marginal effect of specialization across values of import penetration are displayed in Figure 3.3. While the marginal effects of import penetration across values of specialization are displayed in Figure 3.4. In both figures, the thick lines represent the marginal effects, the thick and thin dashed lines represent 90 and 95 percent confidence intervals.

The first model, which contains only the constituent terms of the variables of interest, shows that when holding import penetration constant, increasing specialization decreases spending on lobbying. The real effect of import penetration is expected to be conditional on specialization (and vice versa). Therefore, interpreting the marginal effects of specialization and import penetration is necessary to test the conditional hypotheses outlined earlier. These are calculated and summarized in Figure 3.3 which corresponds to Hypotheses 1, and Figure 3.4 which corresponds to Hypothesis 2. Both marginal effects plots look like those predicted by the theory in Chapter 2. The marginal effect of imports is negative when specialization is low. Suggesting lack of industry cohesiveness and importance for the constituent actors. While specialization is high, increasing imports has a positive effect on lobbying. Again, supporting the idea that when actors are stuck in an industry, industry specific rents and membership matters. For the other side of the interaction, the marginal effect of specialization when import competition is low is negative. Suggesting that increasing specialization when import competition is low to begin with, just decreases the need for lobbying. Lastly, the marginal effect of specialization is positive as expected when import competition is high. This essentially shows how much actors within an industry care about their industry membership when facing foreign competition. When facing foreign competition, decreasing specialization reduces the importance of industry membership (and presumably increases the importance of factor ownership). While increasing specialization under foreign competition increases how stuck actors are within the industry, and increases their preference for lobbying.

Figure 3.3: Marginal Effect of Specialization on Lobbying

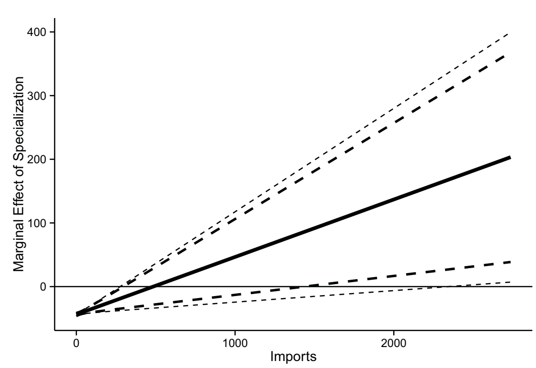


Figure 3.4: Marginal Effect of Import Penetration on Lobbying

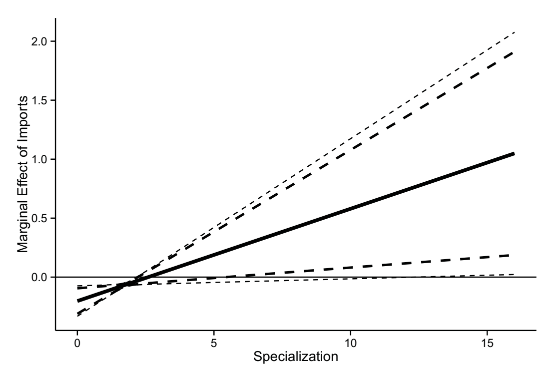


Table 3.3: Results

	Dependent variable:		
	ln(Lobbying)		
	(1)	(2)	(3)
Specialization S_{it}	-0.388	1.216	-0.950
	(0.348)	(0.782)	(0.855)
Imports P_{it}	0.024^{**}	-0.086^{**}	-0.101^{**}
	(0.011)	(0.038)	(0.050)
$S_{it} * P_{it}$		0.023^{*}	0.031^{**}
		(0.014)	(0.019)
Controls:			
Trade Costs			-18.859
			(18.638)
Intra-Industry Trade			0.900
			(2.722)
Total Factor Productivity			2.090
			(3.648)
ΔTFP			10.525
			(9.639)
Employment			-0.068
			(0.0613)
Pay Roll			0.001
			(0.001)
Investment			0.001
			(0.002)
Constant	9.804^{***}	7.944^{***}	7.182
	(1.542)	(1.8732)	(4.505)
Observations	129	129	117
Adjusted R^2	0.045	0.067	0.095
Note:			*p<0.1; **p<0.05; ***p<0.01

3.4 Concluding Remarks

In this dissertation, I build support for my proposed theory in two stages. This chapter is tackles the first stage, whether or not within industry specialization influences collective action (lobbying) behavior in general. When facing some threat (foreign competition) actors will react collectively (lobbying) to protect themselves (tariff). The cohesiveness and intensity of actors acting as an "industry" will depend on the industry's entry/exit costs. If an actor is "stuck" within an industry, they will be more likely to care about that industry's overall welfare.

The next chapter examines the second stage–whether or not industries get the protection (tariff) they prefer as predicted by classical trade models.

4. HETEROGENOUS WITHIN-INDUSTRY SPECIALIZATION, COLLECTIVE ACTION, AND TRADE POLICY

This chapter presents the second empirical test of within industry specialization. I examine the actual political outcomes due to differing levels of within industry specialization. In the last chapter, I provided evidence for higher levels of lobbying spending by high WIS industries. I argued that this is support for my intuition that industry technological complexity creates entry/exit barriers. This makes industry membership a motivating issue for policy preferences. Caring about an industry also helps actors within an industry to overcome collective action problems and lobby more intensely as a single voice. This chapter examines the next theoretical stage after lobbying, the actual trade policy outcomes for an industry. Utilizing import/export data, I am able to test whether or not an industry receives its preferred policy outcome as predicted by well-established trade theories.

4.1 Research Design

The data in this chapter covers a larger scope than the previous chapter which was limited by lobbying data. The empirical analysis in this chapter covers 385 U.S. industries at the 4-digit SIC87 level over 24 years from 1976 to 1999.[1] The data is therefore structured as pooled cross-sectional time series. The dependent variable, tariff rates, varies across industries and time as a response to many heterogenous industry and temporal characteristics. One of these characteristics that is of specific interest in this analysis is industry level relative specialization as a proxy for industry entry and exit costs. To model and control for these time and panel specific variations, multilevel least squares estimators are used. Table 3.1 contains the full

[1]This corresponds to 20 industries at the 2-digit SIC87 level. Summarized in Appendix A.

summary statistics for all the variables used to compile the data in this analysis.

4.2 Dependent and Independent Variables

4.2.1 Trade Protection

The dependent variable used in the analysis is simply the industry tariff rate. One foreseeable limitation of using the tariff rate is that trade protection is potentially obfuscated with non-tariff barriers (Kono 2006). For now however, in this analysis I stick with simple tariff rates. Trade protection is operationalized as the *ad valorem tariff rate* for each year at the 4-digit SIC87 industry level. This variable is computed as duties collected, $duties_{it}$, weighted by the free-on-board customs value of imports, $imports_{it}$, for the respective industry for each industry year and ranges from zero to one. Calculated as $D_{it} = \frac{duties_{it}}{duties_{it}+imports_{it}}$.[2] Available data covers 459 industries over 25 years from 1974 to 1999. Figure 4.1 displays the frequency distribution of the tariff rate. The first, and tallest, bar is when the tariff rate is zero. Figure 4.2 shows the tariff rate as box plots over time. The data comes from the US Customs service and was originally compiled by Feenstra, Romalis and Schott (2002). The particular version used in this prospectus is from Bernard, Jensen and Schott (2006).[3]

[2]An alternative version of this data can also be created from Schott (2008). The $duties_{it}$ reported in the summary statistics is from Schott (2008), hence the discrepancy in the number of observations. This version is used in calculating the alternate dependent variable. The dependent variable used in this chapter was precalculated by Bernard, Jensen and Schott (2006) and spans more observations than Schott (2008).

[3]The data is available on Peter Schott's personal website at `http://faculty.som.yale.edu/peterschott/sub_international.htm`.

Figure 4.1: Distribution of Tariff Rate

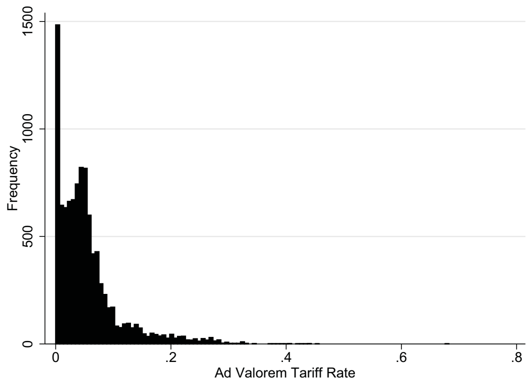
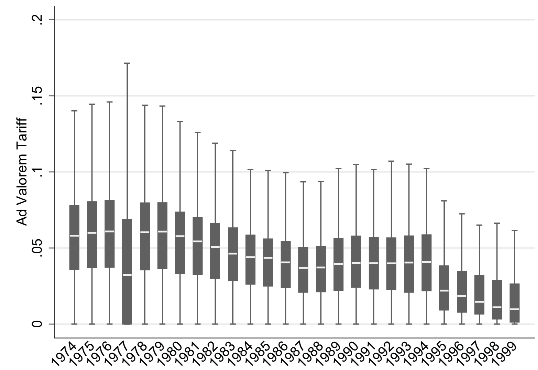


Figure 4.2: Box Plots of Tariff Rate over Time



4.2.2 Within Industry Specialization

This chapter uses the same independent variable as the prior chapter, *within industry specialization*, as a proxy for industry specific entry and exit costs.

4.2.3 Industry Import Competition

Import competition is a key determinant of the political preferences of industries over trade policy. Where the level of Intra-Industry trade (Gilligan 1997), electoral institutions (Kono 2009) and within industry specialization (argued here) determine the ability for economic interests to lobby and gain protection, import competition determines the nature of economic preferences. That is, what economic actors want from their governments. Industries facing import competition that lose income due to cheaper foreign imports are more likely to prefer and lobby for trade protection. Industries facing little competition are conversely, less likely to lobby for trade protection and will have lower trade barriers. Additionally, low import competition industries that are efficient enough to export may in fact lobby for trade liberalization if it is reciprocal, increasing their market exposure abroad (Gilligan 1997). For now, the data used in this prospectus cannot distinguish reciprocity in trade barrier declines. However, this should not be a problem as theoretically we would expect exporters to either not care about decreasing trade barriers in their industry and therefore, not lobby or they would be ok with reductions because they are competitive enough to compete and lobby for reciprocal reductions in barriers. In either case, we would observe low import penetration (potentially exporting) industries having lower trade barriers.

For the purposes of the analysis in this prospectus, import competition is utilized as a proxy for the direction of trade preferences. Simply put, industries facing import competition want protection, and those facing little to no competition do not. Whether or not these industries lobby and/or receive their preferred policy outcome will be conditional on overcoming collective action problems (Gilligan 1997). The ability to overcome collective action problems being determined by the level of industry specific entry/exit costs as measured by within industry specialization. The level of *import competition* is operationalized as import penetration as commonly measured in the literature. Import penetration is calculated as $P_{it} = \frac{imports_{it}}{production_{it} - exports_{it} + imports_{it}}$ where $imports_{it}$ and $exports_{it}$ are imports and exports of each 4-digit SIC87 industry per year and $production_{it}$ is the total domestic production in that industry-year. The interpretation of import penetration is the share of imports as a matter of total domestic consumption. Where domestic consumption is the total level of production of a particular good less exports sent away to be consumed in other countries, plus imports from foreign countries to be consumed domestically. Those with an import penetration equal to one are removed from the sample as these are industries with no consumption of domestically produced goods. They either export everything they produce, or do not produce what so ever (i.e. this industry does not exist in the United States). The data for this variable is taken from Bernard, Jensen, and Schott (2006).

4.2.4 Controls

This chapter uses the same control variables as the prior chapter. These include the Grubel-Lloyed index of "trade overlap" or intra-industry trade, trade costs, total factor productivity, and a number of variables to control for industry size.

4.3 Methodology and Results

The dependent variable for all models is the *ad valorem tariff rate*, D_{it}. The the primary independent variable of interest included in all models is *specialization*, S_{it}, as measured by the 4-digit SIC industry average patent team size. The second variable of interest represents *import competition*, P_{it}, and is measured as import penetration. A number of controls discussed above are included. Models were estimated using least squares with industry fixed effects and cluster robust standard errors at the 4-digit industry level. Models were additionally run with year fixed effects which did not affect the results. The next section reports diagnostics to the effect of potential time series issues and the empirical results are followed by a section tests for potential endogeneity.[4]

4.3.1 Diagnostics

The data used in this chapter in its raw form is the same as the previous chapter. The main difference is that in this chapter I do not create 10-year aggregates of the observations. The same diagnostics were conducted as the previous chapters and the

[4]Earlier model specifications (for the tariff chapter, the lobbying chapters lack of data did not allow for much experimenting with model choice) that were omitted did include year fixed effects. This did not change the results in most cases (except the patent stock variable). It did introduce peculiar time structures into the model residuals of all models that did not exist without them. Additional models attempted included a lagged dependent variable (without fixed effects) with calculated instantaneous impacts and long term effects. These models also did not have drastically different results. These models were removed in much earlier drafts of the dissertation in favor of parsimony in the results section. There are already many models reported as it is.

results from these diagnostics are very similar. Fixed effects with clustered robust standard errors were used for each industry. Residuals plotted against fitted values from the full model without fixed effects displayed minor levels of heteroscedasticity. A likelihood ratio test was conducted to test for panel heteroscedasticity by estimating the full model using an iterated generalized least square estimator taking into account panel heteroscedasticity and one that did not.[5] The results of the likelihood ratio test favor taking into account panel heteroscedasticity. Hausman tests for fixed effects versus random effects reject the null hypothesis that the models yield comparable coefficient estimates. Therefore, the random effects model is rejected over the fixed effects model.

Because of the time series concerns inherent in the structure of the data, panel data unit root and autocorrelation were conducted. The panels were fairly unbalanced, therefore, Fisher-type (Choi 2001) tests were conducted which allow for unbalanced panels. Both both Augmented-Dicky-Fuller and Phillips-Perron versions of the test were conducted on the primary dependent (tariff rate) and independent variables (specialization and import competition). The Fisher-type test performs a unit-root test on each panel separately and then combines the p-values to create an overall test statistic for whether or not the panel data contains a unit root. These tests rejected the null hypothesis that all panels contained a unit root for all three variables. Additionally, an appropriate test for panel data serial autocorrelation was conducted on the same three variables and failed to reject the null hypothesis of no autocorrelation (Wooldridge 2002; Drukker 2003).

The distribution of the patent team size variable shows a decline in density to-

[5] I assume that panels are not correlated with each other. There is no reason to believe they should be so from the theory. The level of within industry specialization in one industry should have no effect on another. Unless, somehow, industries compete with each other on innovation complexity. It is more plausible that if there is competition, it is among firms within the same industry (either domestically or with foreign competitors).

wards values above three team members per patent. This raises the concern that these higher values might be outliers. Additionally, there might be other outlying cases not immediately obvious, therefore I test for multivariate outliers that may be potentially driving my results. To test for multivariate outliers I calculated Cook's distances from the full model. None of the observations have Cook's distances near, but still under, a value of one–the standard cut off value for a multivariate outlier with high influence (Cook 1977; Cook 1979; Cook and Weisberg 1982).[6]

4.3.2 Primary Model Results

Table 4.1 summarizes the regression results for the three models. The first model contains only the main effects specialization and import competition, both of which are negative and statistically significant. And the final model adds a series of controls outlined above. As the marginal effects of the main effects and interaction term depend on the variances and covariances of each other, the coefficients for these terms are not directly interpretable (Brambor et al. 2006; Berry et al. 2012; Aiken and West 1991). Therefore, marginal effects were calculated for specialization and import competition based on the values of the other. The marginal effect of specialization across values of import penetration are displayed in Figure 4.3. While the marginal effects of import penetration across values of specialization are displayed in Figure 4.4. In both figures, the thick lines represent the marginal effects, the thick and thin dashed lines represent 90 and 95 percent confidence intervals.

The first model, which contains only the constituent terms of the variables of interest, shows that when holding import penetration constant, increasing specialization decreases tariff rates. Additionally, the first model shows that increasing import penetration decreases tariffs contrary to conventional theoretical expectations that

[6]There were some multivariate outliers in the simpler models without controls.

increasing import competition increases demand for trade protection. This pattern holds for the next two models. Theoretically the main effect of import penetration should be positive. However, many factors go into determining tariff rates. Omitted variable bias such as the lack of the predicted interaction term and controls might be at play here. In fact once both the interaction and controls are included, the marginal effects plots look like those hypothesized in Chapter 2. The second model contains the two main effects, plus the interaction term between them. Therefore, interpreting the marginal effects of specialization and import penetration is necessary to test the conditional hypotheses outlined earlier. These are calculated and summarized in Figure 4.3 which corresponds to Hypotheses 3, and Figure 4.4 which corresponds to Hypothesis 4. Though the slopes of the marginal effects are not as steep as they would be ideally, both slopes are positive and significant where predicted. Given this I am able to confidently but with some caveats reject that there is no effect of specialization conditional on import penetration (and vice versa). The next section examines a variety of robustness checks.

Table 4.1: Results - Industry Average Team Size

	Dependent variable:		
	Tariff		
	(1)	(2)	(3)
Specialization S_{it}	-0.002^{***}	-0.003^{***}	-0.0024^{***}
	(0.0003)	(0.0004)	(0.0005)
Import Competition P_{it}	-0.038^{***}	-0.048^{***}	-0.0425^{***}
	(0.001)	(0.003)	(0.0054)
$S_{it} * P_{it}$		0.005^{***}	0.0045^{***}
		(0.001)	(0.0015)
Controls:			
Trade Costs			0.121^{***}
			(0.044)
Intra-Industry Trade			0.003
			(0.003)
Total Factor Productivity			-0.009^{**}
			(0.004)
ΔTFP			-0.001
			(0.006)
Employment			0.0002^{***}
			(0.00005)
Pay Roll			$-6.81\text{e-}06^{***}$
			(1.76e-06)
Investment			$8.79\text{e-}06^{***}$
			(2.64e-06)
Constant	0.025^{***}	0.027^{***}	0.013^{***}
	(0.006)	(0.007)	(0.006)
Observations	7,263	7,263	7,193
Adjusted R^2	0.762	0.763	0.773
Note:			*p<0.1; **p<0.05; ***p<0.01

In Figure 4.3, the marginal effect of specialization is negative and statistically significant when import penetration is lower than approximately 0.35 and positive and statistically significant above approximately 0.80. These results support H3 (the negative effect case vs no effect). The marginal effect of import penetration is negative and statistically significant when specialization is lower than approximately 7 and positive and statistically significant above approximately 13 at 90% confidence, and at 95% confidence above approximately 15. These marginal effects support H4.

Figure 4.3: Marginal Effect of Specialization on Tariffs

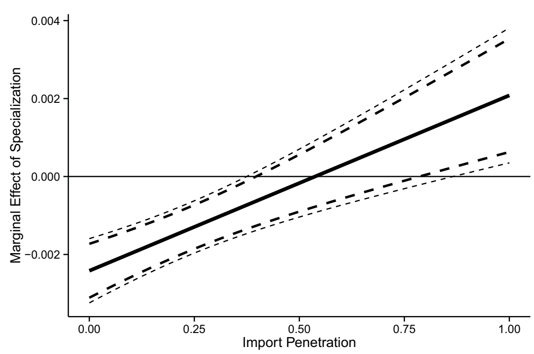
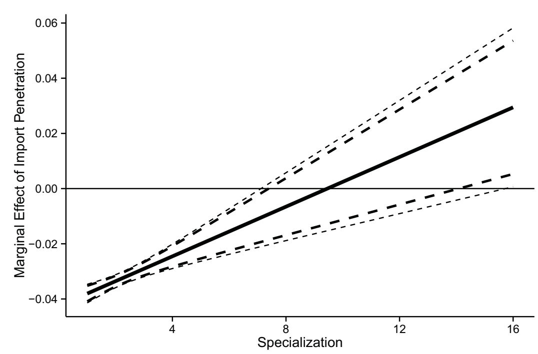


Figure 4.4: Marginal Effect of Import Penetration on Tariffs



4.3.3 Robustness Checks

4.3.3.1 Endogeneity Considerations

There is some cause to be concerned with potential endogeneity between within industry specialization and tariff rates. Better protected industries from tariffs potentially have greater ability to invest in new technologies. This concern luckily has little support empirically. Table 4.2 shows the results from three additional models where within industry specialization is lagged one period, five periods and ten periods into the past. The results hold, and are in fact larger in magnitude for $t-1$ and $t-5$. However, not for $t-10$.[7] Additionally, the concern about endogeneity between greater investment in R&D and within industry specialization are not theoretically consistent or sound with what is presented in this dissertation. There is no guarentee that an industry will invest in more innovations if they are protected. In fact, the conventional wisdom is that the reason industries are protected to begin with is that they are not innovative enough on their own. This is the argument made as to why Latin American import substitution and industrialization policies failed. The protected industries were simply unable to become innovative enough. Either it was too difficult to catch up to the developed economies or protection discourages innovation the way open competition does. Lastly, and most importantly the idea that more innovation leads to more within industry specialization is not a guarantee. While the results do show some similarities between the results from the patent team size models are similar to the results from patent stock and filings, there is no theoretical support that the two necessarily measure complexity of knowledge within an industry. For example, consider an industry that creates 1000 innovations in a particular year. Compare this to another industry that only creates 10 innovations the same year. Which industry has a greater complexity of knowledge? That is, which industry has a greater need for within industry specialization? You cannot tell from just knowing the number of innovations. The important contribution of this dissertation is that you can proxy for complexity by looking at the number of team members are required for innovation. The greater the team size, the more complexity is *inherent* in the body of knowledge. The 1000 innovation industry may average one team member per innovation while the 10 innovation industry may average ten.

[7] I only show the results from the more comprehensive model including controls, but the parsimonious models with only the main independent variables of interest are in line with the models reported in the prior section.

Table 4.2: Results - Lagged Within Industry Specialization

	Dependent variable:		
	Tariff		
	(1)	(2)	(3)
	$t-1$	$t-5$	$t-10$
Specialization S_i	-0.0020^{***}	-0.0014^{***}	-0.0004
	(0.0004)	(0.0005)	(0.0005)
Import Penetration P_i	-0.0945^{***}	-0.0891^{***}	-0.0278^{**}
	(0.0138)	(0.0163)	(0.0135)
$S_i * P_i$	0.00535^{*}	0.057^{**}	0.0011
	(0.0029)	(0.0032)	(0.0026)
Controls:			
Trade Costs	0.1238^{***}	0.1388^{***}	0.1665^{***}
	(0.0438)	(0.0341)	(0.0354)
Intra-Industry Trade	-0.0019^{***}	-0.0006	-0.0063
	(0.0138)	(0.0030)	(0.0037)
Total Factor Productivity	-0.0172^{***}	-0.0167^{***}	-0.0080^{**}
	(0.0055)	(0.0055)	(0.0005)
ΔTFP	0.0068	0.0099^{**}	-0.0167^{***}
	(0.0056)	(0.0049)	(0.0050)
Employment	-0.0001^{**}	0.0001^{**}	0.0002^{***}
	(0.00005)	(0.00006)	(0.00006)
Pay Roll	-0.000006^{***}	-0.000007^{***}	0.000007^{**}
	(0.00001)	$(0.000002)^{***}$	(0.000002)
Investment	0.00008^{***}	0.000008	0.000005^{***}
	(0.00003)	(0.000003)	(0.000002)
Constant	0.07516^{***}	0.0724^{***}	0.0524^{***}
	(0.0071)	(0.0066)	(0.0055)
Observations	6212	4915	3310
Adjusted R^2	0.82	0.85	0.87
Note:			$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

4.3.3.2 Alternative Specifications of Specialization

To check whether or not average team size is a good characterization of within industry specialization and potential influence of outliers, I test a number of additional versions of this variable. I create additional measures of the Minimum, Maximum, and Median industry year team sizes. It could be that is not the average team size but the stock of knowledge in an industry that matters. Therefore, I also use the number of patents filed in an industry year and the cumulative stock of patents in an industry. However, this does not directly flow from the theory presented in this dissertation. I examined this implication further in the preceding section on endogeneity. To summarize, increasing the number of innovations does not necessarily increase complexity (within industry specialization).

The summary statistics and correlations are presented in Table 4.3 and Table 4.4. While the number of patents filed and total stock of patents are not highly correlated with the average, minimum, maximum or median, the model results are all fairly consistent and similar to the original model. These results are summarized in Tables 4.5 through 4.9. Their respective marginal effects are visualized in Figures 4.5 through 4.14. The direction of the coefficient estimates are consistent throughout, negative for both the main effect of specialization and import penetration, and positive for the interaction. Only in the minimum team size is the interaction not significant. However, the interaction still has an effect that is consistent with prior findings when looking at the marginal effects plots.

The fact that import penetration is negative is theoretically irksome. The negative sign is quite robust. Other specifications show it is curvilinear, as a squared term. The finding that it changes directions under an interaction with within industry specialization is also robust. However, the curvilinear effect suggests that many industries with large import penetrations are already "dying" industries which have had their barriers reduced. Once you get past the inflection point of the curve, the import penetration variable has the theoretically expected effect. Increased import penetration increases tariff rates.

Additionally, in the number of patents filed per year model, the main effect of specialization and the interaction are not significant. However, the marginal effects plots, Figure 4.11 show that the effect of specialization is significant at high levels of import penetration and almost significant at a 90% confidence interval when import penetration is really low. Also, for the same model the marginal effect of import penetration in Figure 4.12 is negative and significant when specialization is low, and positive and significant when specialization is moderately high. The same pattern holds for the total stock of patents in an industry but much more significant. Overall the patterns in these models are very consistent with the original measurement of within industry specialization using average team size.

Table 4.3: Alternative Specifications of Specialization Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Minimum	58056	1.26	0.76	1	14
Maximum	58056	3.31	2.16	1	19
Median	58056	1.68	0.914	1	14
# Patents Filed	58056	8.38	24.44	1	434
Stock	58056	95.51	333.33	1	4901

Table 4.4: Alternative Specifications of Specialization Correlation Table

Variables	Average	Minimum	Maximum	Median	# Patents	Stock
Average	1.000					
Minimum	0.755	1.000				
Maximum	0.431	0.031	1.000			
Median	0.922	0.796	0.232	1.000		
# Patents	0.024	-0.035	0.433	0.002	1.000	
Stock	0.029	-0.032	0.408	0.010	0.956	1.000

Table 4.5: Results - Industry Minimum Team Size

	Dependent variable:		
	Tariff		
	(1)	(2)	(3)
Specialization S_{it}	-0.0012^{**}	-0.0016^{***}	-0.0014^{***}
	(0.0005)	(0.0006)	(0.0005)
Import Penetration P_{it}	-0.0389^{***}	-0.0413^{***}	-0.0349^{***}
	(0.0026)	(0.0019)	(0.0032)
$S_{it} * P_{it}$		0.0019	0.0013
		(0.0012)	(0.0012)
Controls:			
Trade Costs			0.121^{***}
			(0.044)
Intra-Industry Trade			0.003
			(0.003)
Total Factor Productivity			-0.009^{**}
			(0.004)
ΔTFP			-0.001
			(0.006)
Employment			0.0002^{***}
			(0.00005)
Pay Roll			$-7.09\text{e-}06^{***}$
			(1.78e-06)
Investment			$9.00\text{e-}06^{***}$
			(2.68e-06)
Constant	0.0596^{***}	0.0602^{***}	0.0573^{***}
	(0.0069)	(0.0087)	(0.006)
Observations	7,263	7,263	7,193
Adjusted R^2	0.761	0.762	0.773
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 4.6: Results - Industry Maximum Team Size

	Dependent variable:		
	Tariff		
	(1)	(2)	(3)
Specialization S_{it}	-0.0079^{***}	-0.0012^{***}	-0.0011^{***}
	(0.0002)	(0.0002)	(0.0002)
Import Penetration P_{it}	-0.0377^{***}	-0.0455^{***}	-0.0407^{***}
	(0.0027)	(0.0055)	(0.0057)
$S_{it} * P_{it}$		0.0002^{***}	0.0020^{***}
		(0.0008)	(0.0008)
Controls:			
Trade Costs			0.120^{***}
			(0.0437)
Intra-Industry Trade			0.0036
			(0.0032)
Total Factor Productivity			-0.0089^{**}
			(0.0042)
ΔTFP			-0.0017
			(0.0061)
Employment			0.0002^{***}
			(0.00006)
Pay Roll			$-6.92\text{e-}06^{***}$
			(1.76e-06)
Investment			$8.77\text{e-}06^{***}$
			(2.63e-06)
Constant	0.0605^{***}	0.0622^{***}	0.0589^{***}
	(0.0068)	(0.0011)	(0.0056)
Observations	7,263	7,263	7,193
Adjusted R^2	0.762	0.763	0.773
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 4.7: Results - Industry Median Team Size

	Dependent variable:		
	Tariff		
	(1)	(2)	(3)
Specialization S_{it}	-0.0014^{***}	-0.0022^{***}	-0.0017^{***}
	(0.0004)	(0.0005)	(0.0004)
Import Penetration P_{it}	-0.0384^{***}	-0.0448^{***}	-0.0387^{***}
	(0.0026)	(0.0038)	(0.0040)
$S_{it} * P_{it}$		0.0034^{***}	0.0030^{***}
		(0.0011)	(0.0011)
Controls:			
Trade Costs			0.121^{***}
			(0.044)
Intra-Industry Trade			0.003
			(0.003)
Total Factor Productivity			-0.009^{**}
			(0.004)
ΔTFP			-0.001
			(0.006)
Employment			0.0002^{***}
			(0.00005)
Pay Roll			$-6.91\text{e-}06^{***}$
			(1.77e-06)
Investment			$8.88\text{e-}06^{***}$
			(2.65e-06)
Constant	0.0604^{***}	0.0618^{***}	0.0584^{***}
	(0.0008)	(0.001)	(0.006)
Observations	7,263	7,263	7,193
Adjusted R^2	0.762	0.762	0.773
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 4.8: Results - Number of Patents Filed Per Industry Year

	Dependent variable:		
	Tariff		
	(1)	(2)	(3)
Specialization S_{it}	-0.00003	-0.00002	-0.00023
	(0.00005)	(0.00006)	(0.00006)
Import Penetration P_{it}	-0.0388^{***}	-0.0383^{***}	-0.0328^{***}
	(0.0026)	(0.0029)	(0.0031)
$S_{it} * P_{it}$		0.00005	0.00004
		(0.00004)	(0.00005)
Controls:			
Trade Costs			0.121^{***}
			(0.044)
Intra-Industry Trade			0.003
			(0.003)
Total Factor Productivity			-0.009^{**}
			(0.004)
ΔTFP			-0.001
			(0.006)
Employment			0.0001^{***}
			(0.00005)
Pay Roll			$-7.11\text{e-}06^{***}$
			(1.78e-06)
Investment			$9.03\text{e-}06^{***}$
			(2.68e-06)
Constant	0.0584^{***}	0.027^{***}	0.0556^{***}
	(0.0006)	(0.007)	(0.0056)
Observations	7,263	7,263	7,193
Adjusted R^2	0.761	0.761	0.772
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 4.9: Results - Industry Total Stock of Patents

	Dependent variable:		
	Tariff		
	(1)	(2)	(3)
Specialization S_{it}	-0.00002^{***}	-0.00002^{***}	-0.00002^{***}
	(4.39e-06)	(6.89e-06)	(5.97e-06)
Import Penetration P_{it}	-0.0367^{***}	-0.0380^{***}	-0.03321^{***}
	(0.0027)	(0.0029)	(0.0030)
$S_{it} * P_{it}$		0.00001^{***}	8.89e-06***
		(4.11e-06)	(3.40e-06)
Controls:			
Trade Costs			0.119^{***}
			(0.043)
Intra-Industry Trade			0.004
			(0.003)
Total Factor Productivity			-0.009^{**}
			(0.004)
ΔTFP			-0.001
			(0.006)
Employment			0.0001^{***}
			(0.00006)
Pay Roll			$-$5.83e-06***
			(1.69e-06)
Investment			7.91e-06***
			(2.58e-06)
Constant	0.0592^{***}	0.0599^{***}	0.0561^{***}
	(0.0006)	(0.0008)	(0.006)
Observations	7,263	7,263	7,193
Adjusted R^2	0.764	0.765	0.774
Note:			*p<0.1; **p<0.05; ***p<0.01

Figure 4.5: Marginal Effect of Specialization (Minimum)

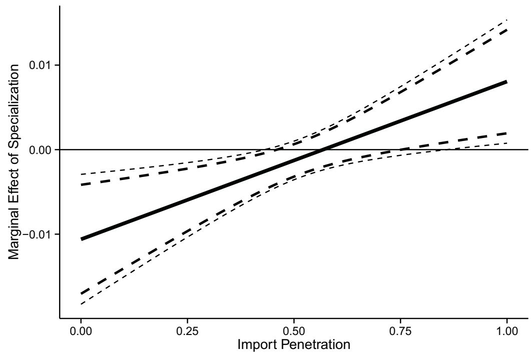


Figure 4.6: Marginal Effect of Import Penetration (Minimum)

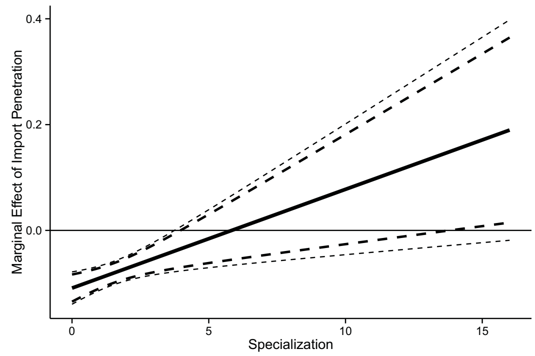


Figure 4.7: Marginal Effect of Specialization (Maximum)

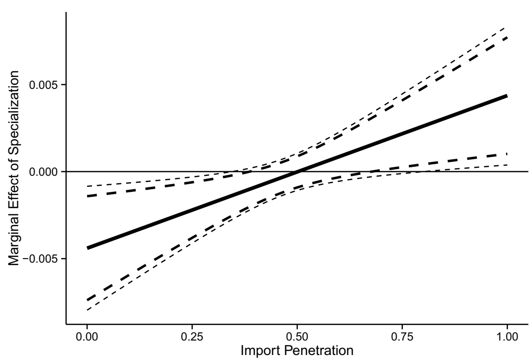


Figure 4.8: Marginal Effect of Import Penetration (Maximum)

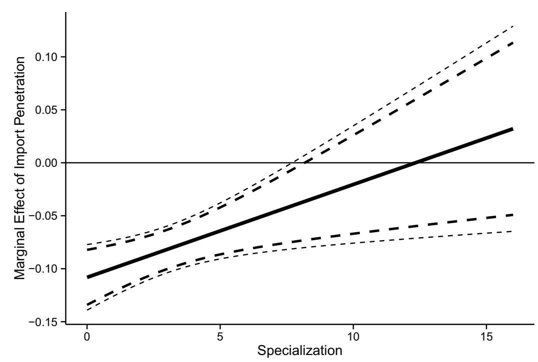


Figure 4.9: Marginal Effect of Specialization (Median)

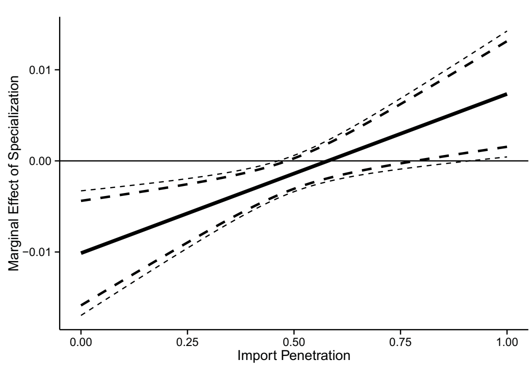


Figure 4.10: Marginal Effect of Import Penetration (Median)

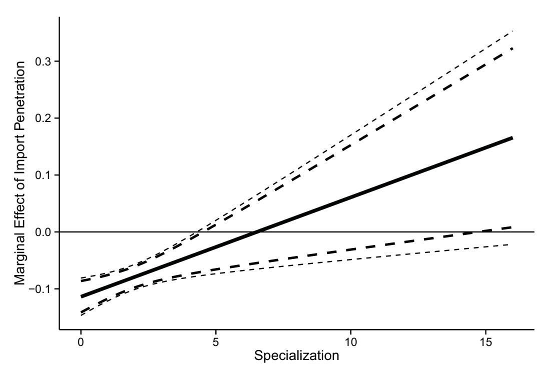


Figure 4.11: Marginal Effect of Specialization (#Patents Filed)

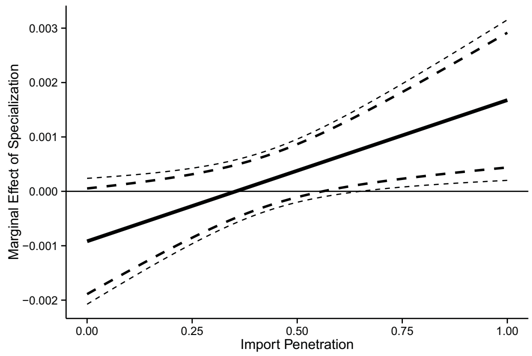


Figure 4.12: Marginal Effect of Import Penetration (#Patents Filed)

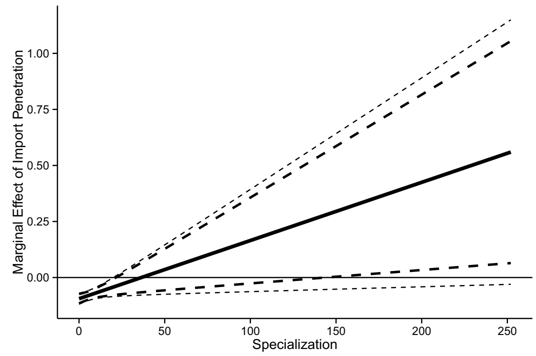


Figure 4.13: Marginal Effect of Specialization (Stock)

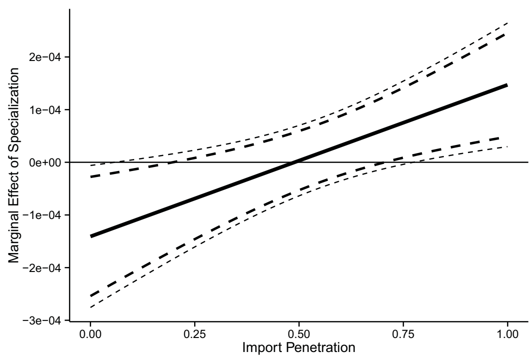
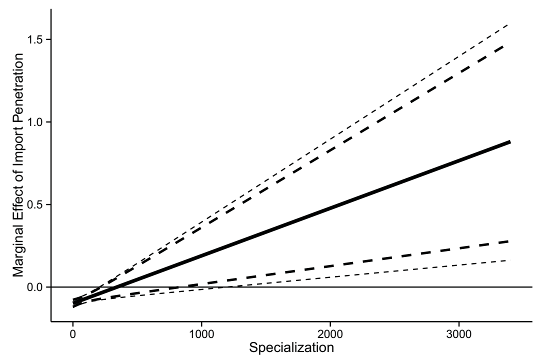


Figure 4.14: Marginal Effect of Import Penetration (Stock)

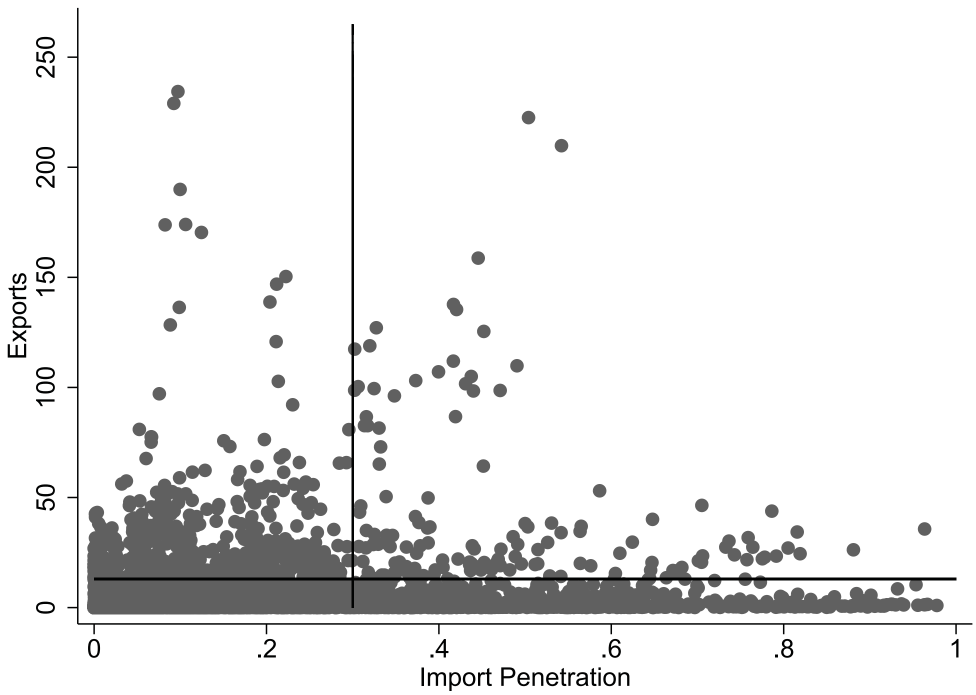


4.3.3.3 Those Most Exposed to Imports

Much of the theory proposed in this dissertation focuses on how actors will behave when exposed to foreign competition. However, many industries are characterized by high intra-industry trade. That is, there is high trade overlap within the same industries–trading cars for cars. Much of world trade between developed economies is of this type. These types of industries may have large levels of imports but also large levels of exports. The patterns of intra-industry trade are governed by scale economies, product differentiation, and consumer love of variety. These industries likely have different preferences on trade barriers than true import competing industries. While, intra-industry trade levels are controlled for in the models, there are other ways these industries might be depressing my results. To tackle which industries my theory is most relevant to, I employ two ways of identifying them. First, I to split the sample into four quadrants of industry "types." The other is to utilize a "modified" Grubel-Lloyed index of trade overlap / intra industry trade.

Those with high exports and little imports as those competitively advantaged. Those industries with high exports and high imports are characterized by intra-industry trade. Those with little imports and exports are either low intra-industry trade or mostly non-tradables. And finally, those of interest to this dissertation are those with high imports but few exports. These four types are displayed in the scatter plot presented in Figure 4.15. The horizontal and vertical lines show the cutoff points chosen to split the sample of industries along exports and import penetration. For both dimensions I set the cutoff points at their respective 90th percentiles. This leaves those industries that are both in the highest ten percent of import penetration and lowest ten percent of exports. If the high intra-industry trade industries are depressing the results, we should observe "stronger" effects by omitting them.

Figure 4.15: Targeting the Most Exposed



The marginal effects of specialization and import penetration are visualized in Figure 4.18 and Figure 4.19 respectively. At first glance the marginal effect of specialization when import penetration is low seems closer to zero, thus less significant. However, it is not, as the magnitude of the marginal effect is about five times larger than the whole sample models estimated before. The same holds true for the marginal effect of import penetration. Again, however, the effect is only positive and significant with a one tailed test at very high values of specialization.

Figure 4.16: Marginal Effect of Specialization (Most Exposed Sample)

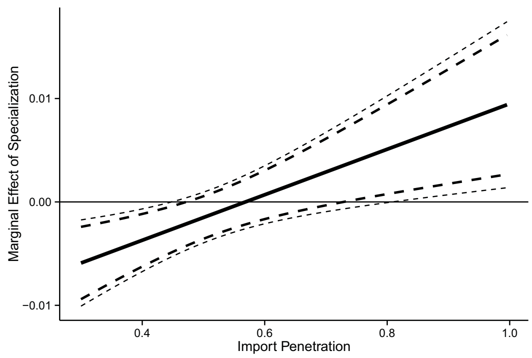
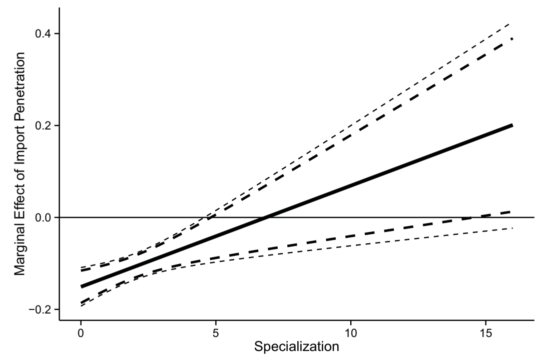


Figure 4.17: Marginal Effect of Import Penetration (Most Exposed Sample)



The other method, utilizing a modified Grubel-Lloyed index anchors high export industries at one end of the index, high import industries at the other, and is centered with those with high overlap. A this index is calculated as $IITm_{it} = \frac{Exports_{it} - Imports_{it}}{Exports_{it} + Imports_{it}}$. This "unwraps" the standard Grubel-Lloyed index so that a value of -1 denotes only exports, 0 is only intra-industry trade, and 1 is only imports. The pattern of the standard Grubel-Lloyed suggests that since 1976, the average level of intra-industry trade in my sample of industries has actually been on a decline in the United States. From the modified Grubel-Lloyed index, one can see that intra-industry trade has been declining due to an increase in imports as a share of trade (448 4-digit SIC industries, over 34 years). This increase in imports in the trade balance matches other observations in the literature (Baldwin 2011). To split the sample, I cut off industry that does not have sufficient level of imports at $IITm_{it} = 0.5$.

Figure 4.18: Marginal Effect of Specialization (Grubel-Lloyed Index)

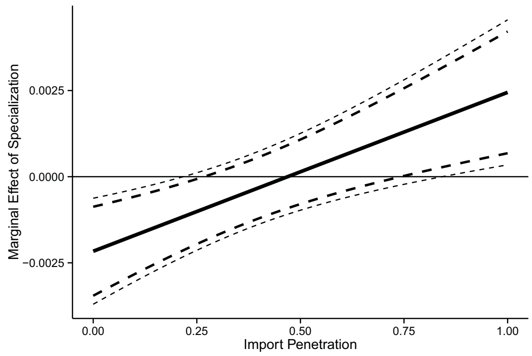
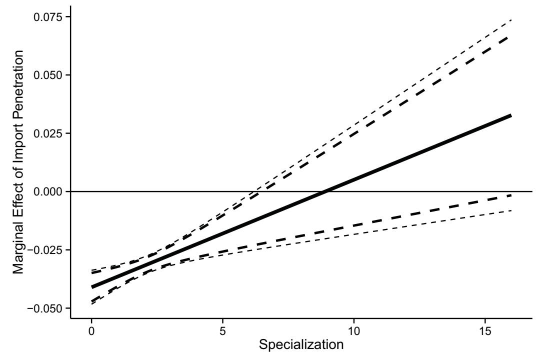


Figure 4.19: Marginal Effect of Import Penetration (Grubel-Lloyed Index)



The results of this model are presented as just the marginal effects. These are visualized in Figure 4.18 and Figure 4.19. The pattern of results is similar and slightly larger in size to those of the whole sample estimated at the beginning of this section. Overall, the results of these two models estimated on those particularly highly exposed to imports suggest that the effects of the two variables are strongest among the most threatened by imports.

4.4 Concluding Remarks

The results are promising. This chapter tests the effects of within industry specialization on trade policy outcomes. There are two important conclusions are drawn from this chapter in regards to the importance of collective action problems on policy outcomes. First, the empirical results reaffirm my theory's assumptions around industry entry/exit cost (factor mobility) heterogeneity and collective action. This supports the intuition behind some earlier work by Alt. et al (1999) who look at individual self-reported asset specificity and lobbing for subsidies in Norway. The cost of entrance and exit for one particular industry is not necessarily the same as another industry's. This means that there are heterogenous expectations on economic actors being able to overcome collective action problems within a particular industry. In trade politics we would expect that import competing industries to have higher tariff rates across the board. The analysis here suggests otherwise. The results emphasize the need to analyze collective action problems, not just the economic interests of industries (Alt et al. 1996). I find that industries that face high import competition must be able to overcome collective action problems to have their voice heard in political negotiations over the tariff (Alt and Gilligan 1994). Otherwise, these industries are potentially sacrificed politically in trade deals.

The second conclusion drawn from this chapter is that industries that are unable to overcome collective action problems are effectively thrown under the bus. That is, in Hypothesis 3, I have two different expectations for when within industry specialization is low. In this case, industry membership does not matter, competitors can crowd into the industry, leaving the industry is cheap, and collective action problems exist.

Two expectations can be envisioned for trade policy outcomes in this industry. One expectation is that (1) import competition has no effect on trade barriers in this industry because actors cannot (or do not even want to) act collectively to increase barriers. This expectation follows the traditional view of trade preferences– actors want protection when facing (foreign) competition. The other expectation is (2) that import competition actually decreases trade barriers in an industry as the industry is essentially allowed to die off in order to get cheaper imports from more efficient foreign producers and to gain reciprocal reductions abroad. The evidence here strongly supports this negative effect on trade barriers. Not only are these industries unable to get protection, they actually have declines in tariff rates. This is exactly what happened time and time again to the textile industry since the 1950's. I cover textile's decline in the next chapter. This conclusion also reemphasizes the importance of economic factors (here, technology) on group cohesiveness and ability to overcome collective action problems when we try to study political outcomes (See Alt et al. 1996, Alt and Gilligan 1994).

5. CONCLUSION

5.1 Autos and Textiles

The continued downfall of textiles in the United States initially seems contrary to the axiom taught to undergraduates every yearthe benefits of protection are concentrated and the costs diffuse.[1] Are the benefits of protectionist policy targeting textiles beneficial only to textiles? That is, can workers in the textile industry exclude workers in other industries from receiving the higher income due to trade barriers? Everything in this dissertation points to *no*. An industry with low barriers to entry/exit, such as my measurement of within-industry specialization, will not be able to hold on to any industry specific rents as competitors crowd into the industry and prices equalize. The benefits of protection are diffuse. This discourages industry specific intensity and cohesiveness of lobbying.

The major decline of the textile industry came in the 1980s. The industry lobby was by now much less influential than it was just post-WW2 (Minchin 2013, pg. 45-). Time and time again the industry lost major legislative and diplomatic battles over beneficial protectionist policy. In 1970, after a protectionist bill died in the senate, Nixon tried to placate the textile industry with negotiated quotas with Japana major exporter of textiles at the time to the United States. These quotas, however, were largely ineffective. They allowed 5% annual increases to exports to the United States and were subject to change on Japan's whim (Minchin 2013, pg. 60). Another bill was passed in 1978 to prevent textile tariff cuts, but was vetoed by President Carter (Minchin 2013, pg. 67). These losses led to, "The Most Important Battle", the Textile and Apparel Trade Enforcement Act of 1985 (H.R. 1562) to get passed by

[1] And the reverse, the costs of free trade are concentrated and the benefits diffuse. Citing marginal benefits and collective action theories, this phrase is at the core of how political scientists and economists answer "if free trade is always beneficial to a country as a whole, why do we ever have protectionism?"

the legislature (Minchin 2013, pg. 117). It was vetoed by President Reagan, and the attempt to override the veto failed. The political losses continued to build with future failures for similar bills in 1987 and 1990 (Minchin 2013, pg. 149-).

Given the relatively low capital, low complexity, and low skilled labor requiring only general easily transferable skills, the textile industry is in a peculiar situation. The fact that factors of production can cheaply move in and out of the textile industry, reduces how much a factor of production cares about being employed in textiles relative to any other industry. I am not saying labor and capital and completely costlessly move to another industry. The initial investment in fixed costs is relatively lower than building, say, a full scale automobile plant. And the intensity of lobbying and industry cohesiveness will be proportional to that in addition to entry and exit costs. Effectively, textiles exist in a phase closer to a Heckscher-Ohlin mobile factors world than a Ricardo-Viner specific factors world. This makes collective action on behalf of the industry less beneficial, while potentially increasing the benefit of collective action on behalf of the factor of production. Again, a relatively unexplored implication of this theory is that both Heckscher-Ohlin and Ricardo-Viner "type" industries exist simultaneously in an economy during the same time period. Other work has varied factor mobility either across time (Hiscox 2001) or across countries (Hiscox 2001, Mukherjee et al. 2009).[2]

Of course, adding to the complexity of understanding collective action problems and free riding, the number of all the owners of a factor in a whole economy is larger than those employed in a single industry. This is not a major concern in my theory as I am comparing lobbying levels between those industries closer to the specific

[2]Only one paper allows mobility to vary by unit. Alt et al. 1999 use R&D intensity and job immobility to measure asset specificity of firms. However, the authors use a subjective measure and do not explore the greater implications to our understanding of market dynamics and political action.

factors world relative to those closer to a mobile factors world. I am not comparing the lobbying efforts of industry versus factor.

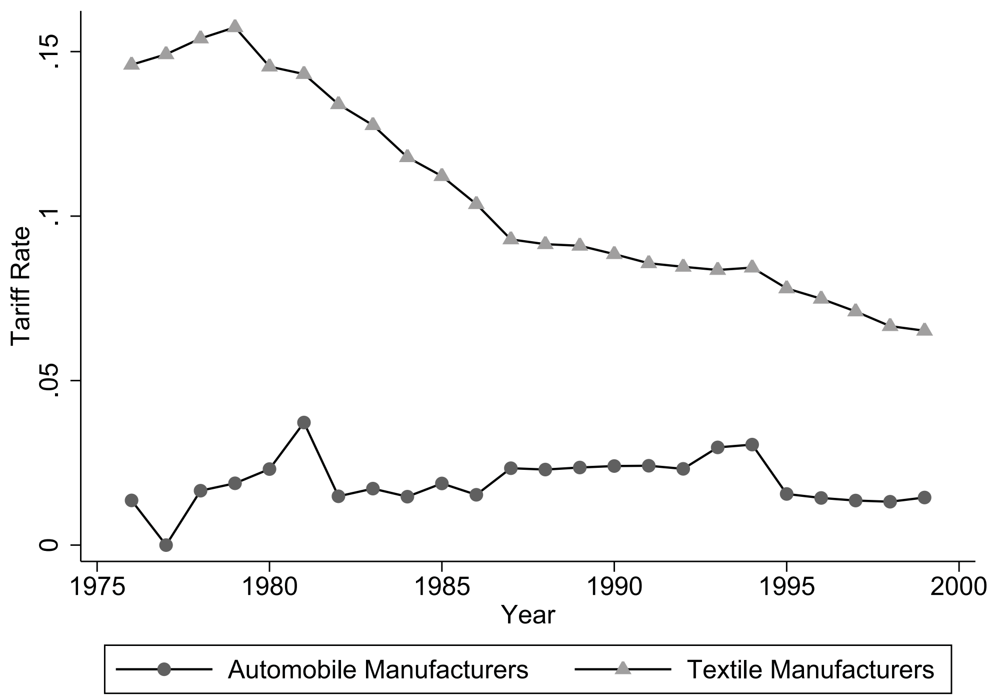
The automobile industry did not face the same fate as textiles for a number of reasons. I emphasize one in particular in this dissertation, high entry and exit barriers. Some of these barriers are due to high scale economies/fixed costs but also associated with the inherent nature of the automobile industry to develop technological complexity. This same complexity helped protect the industry as a natural barrier to entry just like the traditional fixed costse.g. factories, machines, buildings. However, technological complexity also necessitated higher levels of industry specific specialization. If an investor is considering buying a number of machines that can only be used in the production of cars, that investor will care a lot about the auto industry than an investor purchasing machines that can be used in a number of industries. I surmise that high levels of within industry specialization increase the intensity of which actors in a particular industry care about the industry itself, decrease collective action problems more generally thus increasing lobbying expenditures, and ultimately interact with import competition to increase the likelihood of a favorable trade policy outcome.

Admittedly, the automobile industry example I have been uses relies heavily on a non-trade policy measurebailout. The theory more generally does not necessitate a specific type of policy area, just an industry specific policy. If it is an industry-wide bailout or an industry-wide tariff, the theory applies. However, what do tariff rates of the automobile industry look like in comparison to textiles?[3] Figure 5.1 shows the tariff rate between the two. The tariff rate for textiles has taken a nose dive during this time period while the automobile industry's has state relatively stable. If we

[3]As noted before, textiles is actually a very broad group of different 4-digit SIC textile-like industries ranging from flip flop foot ware to cotton gin to apparel. While automobile manufacturing fits much more neatly into a single 4-digit SIC category.

were to take into account quotas and voluntary export restraints, both industries' protection would be even higher. Even so, non-tariff barriers have not replaced tariffs for textiles. The industry is simply becoming less and less protected by trade policy.

Figure 5.1: Auto and Textile Tariffs



5.2 Concluding Remarks

5.2.1 Limitations and Future Research

There are many additional observable implications of within industry specialization that have not been in the scope of this dissertation but are viable avenues to be pursued. First, is WIS's effect on geographical agglomeration of an industry. The textile industry was relatively geographically diffuse compared to automobiles. "We have no Detroits or Pittsburghs. This makes our job harder."[4] I would argue that part of the geographical concentration of the auto industry is driven by the inherent complexity requiring teamwork and closer communication linkages. It has been shown that complex industrial technology increases clustering of firms (Porter 1998), therefore, industry level specialization can influence geographic concentration, or industrial agglomeration of firms in a particular industry. It is advantageous for firms within the same industry to be spatially proximate to each other for the diffusion of specialized knowledge through face-to-face interaction. As specialization necessitates larger team sizes in patent development, it can have the same effect on the demand for specialized labor, collaboration in the supply chain, and other inter-firm linkages. We would expect industries with higher specialization, therefore, to be more likely to geographically cluster near each other. This would further magnify the effect found by Busch and Reinhardt (2000) that geographically concentrated industries are more likely to lobby for protection.[5]

Second, is a more complete evaluation of the validity of within industry specialization as entry and exit costs. I believe Jones (2009) and the research his paper spawned in innovation economics already answered the validity of patent team sizes

[4] John Leslie, Textile Consultant to General Executive Board of the Amalgamated Clothing and Textile Workers Union in 1986. Cited from Minchin (2013, pg 3).

[5] See McGillvray (1997) and Busch and Reinhardt (2000) for earlier work on this topic. Additionally, Rickard (2012) expands this to factor in the effect of electoral institutions.

as a good measure of a body of knowledge's complexity. However, more could be expanded from this dissertation's use of team size as a measurement of one aspect of entry and exit costs–those associated with the need to specialize in industry specific knowledge/use. A number of alternative measures of specialization exist already. The NBER patent data used here additionally offers alternative measurements that could be used as proxies for the theoretical measurement of specialization discussed here. *Generality*, for example, measures the percentage of citations received by a patent in the same patent class. A high generality score means widespread impact on subsequent innovations in a variety of fields. While, *originality*, measures the relative amount of citations a patent receives itself. A high originality score means a patent cites a narrow set of technologies. Lastly, each patent lists a number of claims for which it has uses. This is to specify in detail the building block components and may be indicative of scope or width (Trajtenberg et al. 1997; Hall et al. 2001). These three measurements can potentially substitute for the conceptualization of within industry specialization as complexity of technology/knowledge presented here.

There are a number of empirical limitations that could be improved on in future research. For example, what is the most valid approach to determine the trade policy preference of an industry? Revealed Comparative Advantage (Balassa 1965) could be used instead of import values and penetration. The revealed comparative advantage metric captures a countries propensity to export in a particular industry relative to the rest of the worlds propensity to export in the same industry. Also, the analysis has focused on politically transparent trade barriers, such as the tariff rate. In the future, the analysis should take into account the potential for obfuscation of trade barriers behind less transparent measures such as quality regulations (Kono 2006; Rickard 2012). To continue testing the theory, it will be interesting to examine actual industry and firm lobbying such filing complaints with the International Trade Commission (Gilligan 1997), as well as the voter turnout and preferences of individual laborers (Busch and Reinhardt 2000).

5.2.2 Contributions and Implications

This dissertation builds off prior work in many areas. I link together theories of factor mobility, collective action, scale economies, innovation economics, and international trade. This dissertation fulfills ultimately two functions. First, it integrates existing established theories to paint a more realistic picture of the landscape between the interaction of politics and economics. Second, this dissertation offers an empirical test of not only within industry specialization but also contributes to the foundational theories it is derived from. The empirical results here can be shown as continued support for the importance of taking into account group level collective action problems when studying policy outcomes for a group.

What should a policy maker take away from this dissertation? Technological development does not always increase factor mobility. In fact, there is increasing evidence that at least right now; factor mobility is declining in the United States. And it is declining at a more rapid rate in technologically innovative industries. What are the implications of decreased mobility on policy outcomes? The lack of mobility has been widely associated with higher economic risk (Iversen and Soskice 2001) leading to higher levels of protectionism (Mukherjee et al. 2009).

Ultimately, the policy prescription depends on the goals of the policy maker. Is reducing economic anxieties from import competition and/or factor immobility a primary concern? Then the solution is two fold. The first is commonly proposed: increase funding for trade adjustment assistance and career retraining programs. The second, though seemingly related, is a new implication from within industry specialization. Recall that technology can decrease mobility as I argued here, but can also increase mobility like it has done so in the past. Now and in the future, the body of knowledge in every field is going to become ever greater in depth and breadth. For labor, the limitation is on us. Humans have biological information processing limitations. We can only learn so much in so little time, let alone process all of it. Smart information technologies that help us collate and recall *relevant* information will decrease the reliance on industry specific knowledge. A policy maker in this case should focus public money and policy on increasing information collection and retrieval technologies.

For capital, a cycle of rapid experimentation and divergence is currently occurring. New technologies are invented left and right to solve many real and some made up problems. I believe as technology continues to evolve, the role of the policy maker should be to encourage industry and cross-industry standardization. Either through government intervention or industry self-enforcement. For many automated tasks, a robotic arm that produces cars could very well be used to assemble smart phones or even flip hamburgers. In the robotic arm example, if the technology becomes cheap enough and flexible enough it becomes usable in a broader range of industries.

What about social scientists? The within industry specialization measure described and its effects on market structures are important factors to study as they influence political outcomes. The main take home point of this dissertation for social scientists is twofold. First, industry specific entry and exit cost matter in determining industry cohesiveness and intensity to act on a political issue that affects the industry. Second, technological development can in fact decrease mobility of factors of production. This decline in mobility, due to specialized use to a particular industry, increases how much the industry matters for a factor of production. The second point is the same conclusion drawn from research utilizing the specific factors

(Ricardo-Viner) model of trade to predict political coalitions and preferences but with the innovation of industry specific entry and exit costs. The conclusion is that actors within some industries will care about their industry of membership, while others within the same economy and time will not.

This dissertation examined a single facet of these broader implicationstrade policy. An industry's capability to get and the preference for industry specific protection depend–at least partially–on an industry's technological complexity. I developed a multifaceted theory of "within industry specialization" that borrows from the contributions from recent developments in the innovation economics literature. I link these contributions to well established theories in economies of scale, trade politics, and collective action.

An interesting contribution of the theory is that technology does not always increase factor mobility. As traditionally understood in the literature technological innovations can both increase productivity/efficiency and decrease transaction costs (communications and transportation). However, I point out that technology has another forgotten dimension, complexity. This complexity necessitates that factors of production, with labor being the simplest example, to specialize in increasingly narrow subsets of tasks and knowledge. Some of this knowledge and asks will be industry specific. Once invested in, cannot be utilized in other industries. Of course, certain types of innovations can reverse this trend by making information more easily accessible across bodies of knowledge or more standardized. However, I argue that these are few and far between. In the present day of technological development and complexity, each body of knowledge associated with particular industries is very deep and broad. So much so, that non-transferable skills and knowledge *relatively*, as a proportion of the whole, outnumber the transferable ones.

Lastly, within industry specialization has important implications for offshoring and outsourcing. The increased need for specialization is driven by the complexity of tasks necessary to produce new innovations and knowledge. Tasks done, can be thought of exactly in the same way Grossman and Rossi-Hansberg describe in their "trade in tasks theory of offshoring (2006). This leads to two competing predictions. The first prediction is that the complexity prevents offshoring because tasks are too difficult (too high tech) to be done elsewhere and/or the necessity of network effects and face-to-face communication necessitate tasks to be done proximately to each other. This was described by Busch and Reinhardt (2000) as to why industries concentrate geographically. The second prediction has the opposite effect. The additional complexity, which increases team sizes, introduces potential for more tasks to be introduced into production methods and innovation. These additional tasks can then be moved outside of the firm (outsourced) or country (offshored). These two possibilities do not make my theory less relevant, they definitely make it more relevant and provide testable implications for future research. Testing these implications is right now outside of the scope of the dissertation, which I focus only on the theories implications of collective action and trade protection.

The empirical chapters in this dissertation examined how technological specialization, conditional on the level of foreign competition, affects the ability and intensity of industry lobbying. The results show the importance that individual industry market structures have on the amount of political lobbying and political outcomes (trade protection). The answer to the question raised in Chapter 2, "when facing foreign competition, why do some industries receive trade protection while others do not?", lies with within industry specialization. When specialization is high, and competition is high, industries will lobby more intensely than those with low specialization and/or low competition. And these industries are more likely to receive trade protection than their counterparts.

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APPENDIX A

ADDITIONAL DESCRIPTIVES

A.1 Tables

Table A.1: SIC-87 2-digit Industries

SIC Major groups: (2-digit level)
20: Food and Kindred Products
21: Tobacco Products
22: Textile Mill Products
23: Apparel and other Finished Products made from Fabrics and similar materials
24: Lumber and Wood Products, except Furniture
25: Furniture and Fixtures
26: Paper and Allied Products
27: Printing, Publishing, and Allied Industries
28: Chemicals and Allied Products
29: Petroleum Refining and Related Industries
30: Rubber and Miscellaneous Plastics Products
31: Leather and Leather Products
32: Stone, Clay, Glass, and Concrete Products
33: Primary Metal Industries
34: Fabricated Metal Products, except Machinery and Transportation Equipment
35: Industrial and Commercial Machinery, and Computer Equipment
36: Electronic and other Electrical Equipment, except Computer Equipment
37: Transportation Equipment
38: Measuring, Analyzing, and Controlling Instruments
(Photographic, Medical and Optical Goods; Watches and Clocks)
39: Miscellaneous Manufacturing Industries

Table A.2: SIC-87 4-digit Industry Summary Statistics

Industry Name	SIC87	WIS	Import Pen.	Tariff	Pr. Tariff	Lobbying	ln(Lobbying)	Pr. ln(Lobbying)
Abrasive product	3291	1.880417	.1804599	.0146702	.0461758	.	.	.
Adhesives and se	2891	2.047619	.1119053	.0339373	.0569998	0	.	.
Agricultural che	2879	2.060086	.136285	.0757041	.0522781	.	.	.
Air and gas comp	3563	1.774405	.2370858	.0324871	.0382453	.	.	.
Aircraft	3721	1.868723	.1520303	.0145171	.024884	1.03e+07	16.14337	13.3269
Aircraft engines	3724	1.805204	.2057075	.0058742	.0354677	.	.	.
Aircraft equipme	3728	1.693441	.2408088	.0031779	.0297583	2061223	14.53876	13.35728
Alkalies and chl	2812	2.04058	.154508	.0129363	.0600706	.	.	.
Aluminum extrude	3354	2.65	.089398	.0346251	.0548087	.	.	.
Aluminum foundri	3365	2.394444	.1844028	.0422235	.0588523	.	.	.
Aluminum sheet,	3353	2.729167	.1883752	.0301331	.0462391	.	.	.
Analytical instr	3826	2.044318	.2340413	.0687476	.0392088	.	.	.
Animal and marin	2077	1.7625	.1515803	.0056452	.0551496	.	.	.
Apparel and acce	2389	1.710317	.2172039	.0846707	.0419562	.	.	.
Architectural me	3446	1.934209	.0949221	.0504007	.0591131	0	.	.
Asbestos product	3292	1.75	.2679168	.0176755	.0531203	.	.	.
Asphalt felts an	2952	1.864583	.1380708	.0163406	.0506211	1080000	13.84653	13.32005

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Table A.2 – *Continued from previous page.*

Industry Name	SIC87	WIS	Import Pen.	Tariff	Pr. Tariff	Lobbying	ln(Lobbying)	Pr. ln(Lobbying)
Asphalt paving m	2951	2.0625	.1924715	.0023821	.0481665	.	.	.
Automatic vendin	3581	2.031608	.1310619	.0364073	.0514441	.	.	.
Automotive and a	2396	2.32184	.0931834	.1117341	.0558426	.	.	.
Automotive stamp	3465	2.092593	.1368567	.0305313	.0506396	12800	9.4572	13.61583
Bags: plastics,	2673	1.75	.0721775	.0475266	.0606423	.	.	.
Bags: uncoated p	2674	2.342593	.2284172	.0431222	.0455441	.	.	.
Ball and roller	3562	1.911397	.2427139	.0840198	.0389236	.	.	.
Biological produ	2836	2.039773	.0889913	.0001621	.052612	.	.	.
Blankbooks and l	2782	1.838735	.1321563	.0456323	.0566904	.	.	.
Blast furnaces a	3312	2.405797	.2251606	.0484603	.0435422	.	.	.
Blowers and fans	3564	1.86614	.3015131	.0430954	.0351833	.	.	.
Boat building an	3732	2.102778	.1517247	.0227897	.0572387	970000	13.78505	.
Bolts, nuts, riv	3452	1.835714	.2627491	.0446059	.0408128	.	.	.
Book publishing	2731	1.922222	.1833518	.000281	.0575894	0	.	.
Bras, girdles, a	2342	1.833333	.3801337	.2054094	.0262274	.	.	.
Bread, cake, and	2051	2.466667	.0100901	.0082715	.0662402	.	.	.
Brick and struct	3251	1.676471	.1330956	.0214328	.062993	60000	11.0021	8.962237
Broadwoven fabri	2211	2.064815	.2319895	.0932271	.0467548	.	.	.
Broadwoven fabri	2221	2.125833	.174331	.1631885	.0521274	842500	13.52179	13.14686

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Table A.2 – *Continued from previous page.*

Industry Name	SIC87	WIS	Import Pen.	Tariff	Pr. Tariff	Lobbying	ln(Lobbying)	Pr. ln(Lobbying)
Broadwoven fabri	2231	2.25303	.2117624	.2847473	.0432612	.	.	.
Brooms and brush	3991	1.606351	.2226513	.0649195	.0460075	.	.	.
Calculating and	3578	2.022727	.4556055	.030672	.0183997	.	.	.
Candy and other	2064	2.125	.2303485	.0322963	.0449767	1055000	13.85667	13.74756
Cane sugar refin	2062	2.2	.1692096	.0138463	.0534308	.	.	.
Canned and cured	2091	2.291667	.6075512	.0478086	.0086604	742021	13.40467	13.3617
Canned specialti	2032	2.355833	.104533	.0611437	.0560576	100000	11.51293	13.57004
Canvas and relat	2394	1.716667	.2579414	.0932669	.0435164	.	.	.
Carbon and graph	3624	2.003374	.2063502	.0402318	.0453449	.	.	.
Carbon black	2895	2.183333	.1426503	.000324	.0519109	2.19e+07	16.89414	12.73614
Carbon paper and	3955	1.753722	.2161488	.0717698	.0436344	.	.	.
Carpets and rugs	2273	1.911765	.1742082	.0729797	.0507294	0	.	.
Cellulosic manma	2823	2.328788	.15682	.0907509	.0501378	.	.	.
Cement, hydrauli	3241	2.083333	.1992417	.0000797	.0646885	.	.	.
Ceramic wall and	3253	1.692308	.4110406	.1988452	.0395441	.	.	.
Cereal breakfast	2043	1.428571	.2890851	.0159068	.0396821	10000	9.21034	13.31311
Cheese, natural	2022	1.869048	.1017071	.095403	.058924	.	.	.
Chemical prepara	2899	2.009575	.1565496	.0413166	.0534433	.	.	.
Chewing and smok	2131	2.333333	.1998245	.0627822	.0451486	.	.	.

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Table A.2 – *Continued from previous page.*

Industry Name	SIC87	WIS	Import Pen.	Tariff	Pr. Tariff	Lobbying	ln(Lobbying)	Pr. ln(Lobbying)
Chewing gum	2067	2.083333	.1925575	.0480602	.0457188	.	.	.
Chocolate and co	2066	2.075	.2802192	.0283	.040585	.	.	.
Cigarettes	2111	1.641026	.079694	.1959622	.0524929	2.37e+07	16.98146	13.73886
Cigars	2121	1.621212	.2336749	.0839744	.0364622	.	.	.
Clay refractorie	3255	1.436508	.120456	.026246	.0558453	.	.	.
Coated fabrics,	2295	2.276515	.1659097	.0929233	.049708	.	.	.
Coffee, roasted	2095	2.10119	.1096666	.0003324	.0536637	3497334	15.06751	13.29268
Commercial print	2752	1.811111	.1037632	.0147178	.052068	.	.	.
Communications e	3669	1.841424	.1823661	.0362893	.043954	.	.	.
Computer periphe	3577	1.931499	.3498539	.0291735	.0274602	.	.	.
Computer storage	3572	1.909576	.3502666	.0191105	.0312145	8709646	15.97838	15.30396
Concrete block a	3271	2.297619	.1489341	.0483279	.0576211	.	.	.
Concrete product	3272	1.841228	.1125283	.0618941	.0547088	20000	9.903487	13.50736
Construction mac	3531	1.835299	.2214588	.024554	.0401843	.	.	.
Converted paper	2679	2.17963	.0817756	.0198842	.0568503	.	.	.
Conveyors and co	3535	1.703427	.1441582	.0251253	.0497169	.	.	.
Copper rolling a	3351	2.045455	.0832043	.018054	.0573561	.	.	.
Cordage and twin	2298	1.618116	.2847201	.0552325	.0433055	.	.	.
Corrugated and s	2653	2	.2266273	.0302309	.0453047	20000	9.903487	13.1913

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Table A.2 – *Continued from previous page.*

Industry Name	SIC87	WIS	Import Pen.	Tariff	Pr. Tariff	Lobbying	ln(Lobbying)	Pr. ln(Lobbying)
Costume jewelry	3961	1.25	.3604043	.1459125	.0323668	.	.	.
Cottonseed oil m	2074	2.29902	.0766118	.0218783	.058866	.	.	.
Creamery butter	2021	2.448718	.1560751	.1210653	.0489025	.	.	.
Crowns and closu	3466	1.961905	.1310972	.0474636	.0557311	.	.	.
Currentcarrying	3643	1.935455	.1869948	.0510818	.0436476	.	.	.
Curtains and dra	2391	1.619792	.1650003	.123755	.0533186	.	.	.
Cut stone and st	3281	2.25	.3465889	.0500036	.0425035	20000	9.903487	12.94918
Cutlery	3421	1.757609	.2863595	.1046435	.0361762	.	.	.
Cyclic crudes an	2865	2.04828	.2439119	.0452791	.044962	.	.	.
Dehydrated fruit	2034	1.903241	.1725172	.0708838	.0530089	.	.	.
Dental equipment	3843	2.28612	.1548319	.0514002	.0462638	.	.	.
Diagnostic subst	2835	2.197101	.1236542	.0122405	.0488573	.	.	.
Diecut paper and	2675	2.157018	.084423	.0405199	.0555896	.	.	.
Distilled and bl	2085	2.597222	.3843594	.0390572	.0280821	.	.	.
Dog and cat food	2047	1.9375	.0729514	.0002875	.06049	.	.	.
Dolls and stuffe	3942	1.469841	.724739	.0837301	-.0014551	.	.	.
Drapery hardware	2591	1.677392	.1663683	.0424564	.0531471	.	.	.
Dry, condensed,	2023	1.97193	.1479656	.003869	.0533954	.	.	.
Edible fats and	2079	2.066667	.1893182	.0272755	.0506186	.	.	.

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Table A.2 – *Continued from previous page.*

Industry Name	SIC87	WIS	Import Pen.	Tariff	Pr. Tariff	Lobbying	ln(Lobbying)	Pr. ln(Lobbying)
Electric housewa	3634	1.808006	.2429864	.0388866	.04144	390000	12.86562	13.91042
Electrical equip	3699	2.018905	.2488838	.042229	.038082	.	.	.
Electrical indus	3629	1.895257	.3301421	.0623515	.0306193	.	.	.
Electromedical e	3845	2.135347	.2884089	.0332598	.0299704	.	.	.
Electrometallurg	3313	2.102564	.4875213	.0197302	.0213045	.	.	.
Electron tubes	3671	2.151311	.1402328	.052782	.0490134	.	.	.
Electronic capac	3675	2.055038	.3725302	.0825588	.029563	.	.	.
Electronic coils	3677	1.860369	.2310294	.042013	.0425014	.	.	.
Electronic compo	3679	2.10471	.2517596	.0365607	.0359727	.	.	.
Electronic compu	3571	1.621699	.3316356	.023184	.0194258	.	.	.
Electronic conne	3678	1.893737	.2536975	.0462266	.0399408	.	.	.
Electronic resis	3676	1.989568	.3753795	.0503679	.029168	.	.	.
Elevators and mo	3534	1.75099	.1468995	.0244361	.0516781	2091818	14.51877	13.63745
Engine electrica	3694	1.967202	.2814597	.0276586	.0347264	.	.	.
Envelopes	2677	1.577778	.0685572	.0479359	.0599029	.	.	.
Environmental co	3822	1.797644	.1856315	.0476645	.0439085	.	.	.
Explosives	2892	2.16189	.1326736	.0185078	.051656	20000	9.903487	13.21442
Fabricated metal	3499	1.65362	.1311189	.0442192	.053441	.	.	.
Fabricated plate	3443	1.56644	.125309	.0373036	.0497321	.	.	.

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Table A.2 – *Continued from previous page.*

Industry Name	SIC87	WIS	Import Pen.	Tariff	Pr. Tariff	Lobbying	ln(Lobbying)	Pr. ln(Lobbying)
Fabricated rubbe	3069	1.960714	.1449418	.0450319	.0506354	.	.	.
Fabricated struc	3441	1.919167	.107785	.0406273	.0534186	.	.	.
Fabricated texti	2399	1.719571	.2512096	.0848981	.0421205	.	.	.
Fabricated wire	3496	1.739975	.2376629	.0342393	.0444158	.	.	.
Farm machinery a	3523	1.792012	.2531713	.0002685	.0350565	.	.	.
Fasteners, butto	3965	1.683471	.2812067	.0857002	.0380552	.	.	.
Fiber cans, drum	2655	1.601754	.1204572	.0453205	.0553319	.	.	.
Flat glass	3211	1.853968	.1964094	.0376472	.0528236	.	.	.
Flavoring extrac	2087	1.962879	.1021304	.0751157	.0543799	.	.	.
Flour and other	2041	2.283333	.114715	.0262909	.0600085	.	.	.
Fluid meters and	3824	1.707759	.1988143	.0375342	.0392943	.	.	.
Fluid milk	2026	1.933333	.0672646	.0503735	.0662179	.	.	.
Fluid power cyli	3593	1.916643	.2030685	.0318916	.0433662	.	.	.
Fluid power pump	3594	1.949264	.1691873	.0306732	.0450519	.	.	.
Fluid power valv	3492	1.877881	.1948052	.049988	.0431646	.	.	.
Folding paperboa	2657	1.364583	.1322831	.0330333	.0536302	596291.5	13.25275	13.27904
Food preparation	2099	2.547619	.1199307	.0396357	.0589432	.	.	.
Food products ma	3556	1.763965	.2520907	.0371711	.0397089	.	.	.
Footwear cut sto	3131	1.333333	.6107888	.0455155	.0019539	.	.	.

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Table A.2 – *Continued from previous page.*

Industry Name	SIC87	WIS	Import Pen.	Tariff	Pr. Tariff	Lobbying	ln(Lobbying)	Pr. ln(Lobbying)
Footwear, except	3149	1.857143	.7623465	.0819055	-.0098925	160000	11.98293	14.04911
Frozen fruits an	2037	1.5	.1522008	.1527783	.0585706	.	.	.
Fruits and veget	2033	1.666667	.2068973	.1181805	.0553547	.	.	.
Fur goods	2371	2.166667	.5600663	.0622608	.0058461	.	.	.
Furniture and fi	2599	1.821429	.2328756	.0330421	.0470188	.	.	.
Games, toys, and	3944	1.540909	.4453206	.0693436	.0241103	160000	11.97505	13.89202
Gaskets,packing,	3053	1.669778	.1388481	.0286652	.0500557	.	.	.
General industri	3569	1.932374	.2518204	.0335131	.0388694	.	.	.
Girls, children'	2369	1.166667	.2840161	.2141145	.0437248	.	.	.
Glass containers	3221	1.697727	.122935	.0223808	.0552036	.	.	.
Glass products	3231	1.810317	.1493958	.0580166	.0531049	460000	13.03898	12.86034
Gloves, dress an	2381	2.111111	.4913346	.1942133	.0144751	1347250	14.10212	13.82558
Gray iron foundr	3321	2.342105	.1350597	.028209	.0516851	.	.	.
Greeting card pu	2771	1.865217	.0960626	.0509833	.0668122	140000	11.83909	.
Guided missiles	3761	1.990823	.1275168	.0085344	.0377516	.	.	.
Gum and wood che	2861	1.948876	.1759384	.0158597	.0539705	.	.	.
Gypsum products	3275	1.541667	.102173	.0325407	.0580693	.	.	.
Hand and edge to	3423	1.713605	.2427997	.057856	.0406612	.	.	.
Hand saws and sa	3425	1.777295	.1972963	.0286391	.0424425	285000	12.53354	13.87121

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Table A.2 – *Continued from previous page.*

Industry Name	SIC87	WIS	Import Pen.	Tariff	Pr. Tariff	Lobbying	ln(Lobbying)	Pr. ln(Lobbying)
Hard surface flo	3996	2.25779	.1419982	.0571604	.0544393	.	.	.
Hardware, NEC	3429	1.618471	.1716253	.0463383	.0474938	.	.	.
Hardwood dimensi	2426	1.691304	.149292	.030026	.0552822	.	.	.
Hardwood veneer	2435	1.625	.3151161	.091448	.0451055	.	.	.
Hats, caps, and	2353	2.065476	.3755995	.1115755	.0309735	.	.	.
Heating equipmen	3433	1.682609	.1584435	.0383954	.052813	.	.	.
Hoists, cranes a	3536	1.889987	.1850381	.0248045	.0447396	.	.	.
Hosiery, NEC	2252	1.545455	.0256952	.2163949	.066458	.	.	.
House furnishing	2392	1.944513	.1894054	.1077092	.0507704	.	.	.
House slippers	3142	1.722222	.1428536	.0782796	.0531651	.	.	.
Household applia	3639	1.701648	.236262	.0334942	.041189	.	.	.
Household audio	3651	1.873672	.6223771	.0422285	.003124	1.12e+07	16.23555	14.52606
Household cookin	3631	1.672727	.2317685	.0320805	.0418699	.	.	.
Household laundr	3633	1.746712	.1337059	.0423623	.0512389	.	.	.
Household refrig	3632	1.669501	.1491833	.027968	.0518521	.	.	.
Household vacuum	3635	1.847619	.162491	.0343388	.0475316	.	.	.
Ice cream and fr	2024	2.606061	.1819478	.1929443	.0759209	.	.	.
Ice, manufacture	2097	1.701549	.1015873	0	.0592634	.	.	.
Industrial gases	2813	2.156806	.212653	.012002	.0450102	.	.	.

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Table A.2 – *Continued from previous page.*

Industry Name	SIC87	WIS	Import Pen.	Tariff	Pr. Tariff	Lobbying	ln(Lobbying)	Pr. ln(Lobbying)
Industrial inorg	2819	2.155465	.2656567	.0072586	.0395326	.	.	.
Industrial machi	3599	2.171999	.1971427	.0376044	.0399782	.	.	.
Industrial organ	2869	1.992082	.158496	.0285042	.0678809	.	.	.
Industrial patte	3543	1.835887	.0960645	.0390197	.0525558	.	.	.
Industrial proce	3567	1.871068	.1767366	.0382512	.0459611	.	.	.
Industrial truck	3537	1.955949	.27453	.0156293	.0376121	.	.	.
Inorganic pigmen	2816	2.23844	.2279505	.0483777	.0480811	.	.	.
Instruments to m	3825	1.818806	.2177507	.0506034	.0384986	.	.	.
Internal combust	3519	1.833296	.2385341	.0199574	.0379548	.	.	.
Jewelers' materi	3915	1.8125	.6990136	.0256615	-.0046804	.	.	.
Jewelry, preciou	3911	3.104167	.6794559	.0454339	-.0027703	60000	11.0021	14.01289
Lace and warp kn	2258	2.259921	.1298982	.1742837	.0544599	54000	10.89674	12.55699
Lawn and garden	3524	1.889417	.1168287	.0176015	.0538571	.	.	.
Lead pencils and	3952	1.898368	.1814089	.0673114	.0488226	.	.	.
Leather and shee	2386	1.818182	.6746188	.0601031	.0046094	.	.	.
Leather gloves a	3151	1.291667	.5893722	.1511561	.0071236	.	.	.
Leather goods, N	3199	2	.4630004	.0214127	.0204818	.	.	.
Leather tanning	3111	1.65	.2885582	.0365269	.034598	.	.	.
Lighting equipme	3648	1.775059	.1810096	.0658721	.0489348	.	.	.

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Table A.2 – *Continued from previous page.*

Industry Name	SIC87	WIS	Import Pen.	Tariff	Pr. Tariff	Lobbying	ln(Lobbying)	Pr. ln(Lobbying)
Lime	3274	2.103333	.1586184	.0041127	.0546742	3635816	15.10589	13.05762
Logging	2411	1.767857	.1550925	.000053	.069415	.	.	.
Luggage	3161	1.357143	.5757492	.1515364	.0123773	.	.	.
Macaroni and spa	2098	2.5	.1291399	.0055787	.0610279	.	.	.
Machine tool acc	3545	1.700423	.1302046	.0792581	.0484304	.	.	.
Machine tools, m	3541	1.945052	.4136408	.0512044	.0207815	.	.	.
Machine tools, m	3542	1.822454	.2736537	.0470821	.0349987	.	.	.
Magnetic and opt	3695	1.795	.3067688	.0360579	.035955	.	.	.
Malt	2083	2.333333	.1753285	.0173948	.0578216	.	.	.
Malt beverages	2082	2.421053	.1546316	.0181567	.0582045	2408660	14.69114	13.75984
Manifold busines	2761	1.365385	.1680616	.0387427	.0501719	.	.	.
Manufacturing in	3999	1.863557	.3400027	.0664985	.0366445	30000	10.30895	13.21033
Mattresses and b	2515	1.458333	.1695358	.0374055	.0524986	.	.	.
Measuring cont	3829	2.15239	.2291112	.051902	.0391307	345404	12.75177	13.14749
Measuring and di	3586	1.873599	.1523234	.0289542	.0500916	.	.	.
Meat packing pla	2011	1.94881	.0472953	.0195126	.0660689	.	.	.
Medicinals and b	2833	2.163527	.4978494	.048325	.015736	.	.	.
Men’s and boys’	2329	2.270175	.3287825	.2076136	.0371674	.	.	.
Men’s and boys’	2323	1.661905	.2245185	.1175817	.0422358	.	.	.

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Table A.2 – *Continued from previous page.*

Industry Name	SIC87	WIS	Import Pen.	Tariff	Pr. Tariff	Lobbying	ln(Lobbying)	Pr. ln(Lobbying)
Men's and boys'	2321	1.636364	.3124178	.2443567	.0413252	.	.	.
Men's and boys'	2311	1.640625	.3289775	.207159	.0355986	.	.	.
Men's and boys'	2325	1.166667	.1531082	.2210754	.0567259	.	.	.
Men's and boys'	2322	1.812745	.4189444	.1871382	.0290807	0	.	.
Men's footwear,	3143	1.545455	.4439533	.0874728	.0229456	.	.	.
Metal barrels, d	3412	1.650227	.1197163	.0177941	.0542185	.	.	.
Metal cans	3411	1.468841	.0967178	.0367563	.0565347	30000	10.25006	13.22175
Metal doors, sas	3442	1.487121	.0990643	.0439615	.0569362	.	.	.
Metal foil and l	3497	1.844824	.1529438	.0373408	.0489963	.	.	.
Metal household	2514	1.181818	.1729955	.0402685	.0639255	.	.	.
Metal sanitary w	3431	1.790351	.1706419	.0421829	.0468475	.	.	.
Metal stampings,	3469	1.694862	.1526455	.0512043	.0490794	.	.	.
Millwork	2431	1.611111	.1349287	.0194002	.0522424	220000	12.30138	13.30007
Mineral wool	3296	1.616667	.1489173	.0572404	.0551477	.	.	.
Minerals, ground	3295	2.315909	.1319372	.0165253	.0593488	.	.	.
Mining machinery	3532	1.782129	.2309985	.0298536	.0409223	20000	10.59663	13.24131
Miscellaneous st	3449	1.837122	.0972251	.0463795	.0557379	.	.	.
Mobile homes	2451	1.818182	.1954864	.0205568	.064618	777383.5	13.56359	.
Motor vehicle pa	3714	2.042918	.243426	.0181158	.0342794	.	.	.

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Table A.2 – *Continued from previous page.*

Industry Name	SIC87	WIS	Import Pen.	Tariff	Pr. Tariff	Lobbying	ln(Lobbying)	Pr. ln(Lobbying)
Motor vehicles a	3711	1.640271	.3378795	.0195236	.0256186	.	.	.
Motorcycles, bic	3751	1.771066	.5804395	.0526602	.0066635	.	.	.
Motors and gener	3621	1.841201	.2451541	.0430796	.0388391	.	.	.
Musical instrume	3931	1.61238	.4436082	.0739584	.0219938	0	.	.
Narrow fabric mi	2241	2.2	.2027352	.0874647	.046251	.	.	.
Newspapers	2711	1.454545	.1834387	.0000294	.068508	.	.	.
Nitrogenous fert	2873	2.40368	.2616978	.0021139	.0483036	960000	13.77469	12.48192
Nonclay refracto	3297	1.912037	.1574185	.0280184	.0532883	.	.	.
Noncurrentcarryi	3644	1.833777	.1662256	.0523139	.0472242	40000	10.59663	13.4727
Nonferrous rolli	3356	1.54932	.2167629	.0309735	.0393412	.	.	.
Nonferrous wire	3357	1.909009	.1597158	.0467394	.0499168	.	.	.
Nonmetallic mine	3299	1.733063	.2322855	.0377082	.0412573	.	.	.
Nonwoven fabrics	2297	2.0325	.1412359	.1190089	.0518461	.	.	.
Office furniture	2522	1.490196	.1879754	.0490208	.0510568	.	.	.
Office machines,	3579	2.114646	.3075324	.0283863	.0305842	1987052	14.50207	13.80098
Oil and gas fiel	3533	1.735076	.4537061	.0270717	.0126605	.	.	.
Ophthalmic goods	3851	2.240368	.3554977	.089604	.0291264	.	.	.
Optical instrume	3827	2.050415	.2777284	.0885131	.0364369	.	.	.
Ordnance and acc	3489	1.807287	.1693348	.038366	.0461507	.	.	.

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Table A.2 – *Continued from previous page.*

Industry Name	SIC87	WIS	Import Pen.	Tariff	Pr. Tariff	Lobbying	ln(Lobbying)	Pr. ln(Lobbying)
Organic fibers,	2824	1.931818	.1244709	.0903499	.057523	.	.	.
Packaging machin	3565	2.03863	.2306435	.0347418	.0397032	.	.	.
Paints and allie	2851	1.992857	.1037162	.0425901	.055102	.	.	.
Paper coated and	2672	2.055087	.1199444	.0485653	.054439	.	.	.
Paper industries	3554	1.740608	.3086328	.0209729	.0329509	.	.	.
Paper mills	2621	1.910749	.2383109	.0039663	.0525409	0	.	.
Paperboard mills	2631	1.897059	.1195438	.0110517	.072283	.	.	.
Partitions and f	2542	1.508772	.1812787	.0375875	.0502045	.	.	.
Pens and mechani	3951	1.858696	.2823139	.1017434	.0362114	.	.	.
Periodicals	2721	1.590909	.0977272	0	.0587799	.	.	.
Personal leather	3172	1.736927	.4420685	.1024633	.0238399	.	.	.
Petroleum and co	2999	1.941667	.2424197	.0038822	.0439355	.	.	.
Petroleum refini	2911	2.559524	.1758002	.0067006	.0731673	3513500	15.07175	16.42954
Pharmaceutical p	2834	2.265363	.1148024	.028798	.0520204	5.64e+07	17.84091	15.86123
Phosphatic ferti	2874	2.131263	.1530107	.0001789	.0554497	.	.	.
Photographic equ	3861	2.008421	.2597633	.042288	.0358429	1350000	14.07204	14.31222
Pickles, sauces,	2035	1.912319	.1086077	.0742776	.0618983	.	.	.
Plastics bottles	3085	1.933204	.1296244	.0446512	.0566408	.	.	.
Plastics materia	2821	2.019755	.1349166	.0709743	.0624897	.	.	.

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Table A.2 – *Continued from previous page.*

Industry Name	SIC87	WIS	Import Pen.	Tariff	Pr. Tariff	Lobbying	ln(Lobbying)	Pr. ln(Lobbying)
Plastics plumbin	3088	1.695467	.1308935	.0528176	.0658638	2358438	14.6735	.
Plastics product	3089	1.687522	.1320461	.0523423	.0628476	.	.	.
Platemaking and	2796	2.301111	.1356501	.0096091	.0660128	.	.	.
Pleating and sti	2395	2.002899	.0992493	.1249642	.0589713	0	.	.
Plumbing fixture	3432	1.974561	.0693131	.0521854	.0569558	112000	11.62625	14.11684
Polishes and san	2842	2.099992	.093665	.0233167	.057284	3977662	15.19394	12.87213
Porcelain electr	3264	2.428571	.1934903	.0528959	.0429231	.	.	.
Potato chips and	2096	1.931373	.1451232	.0547157	.0559005	.	.	.
Pottery products	3269	1.276923	.7074053	.0898652	.0024591	.	.	.
Poultry slaughte	2015	2.295614	.1068179	.0183633	.0613407	.	.	.
Power transmissi	3568	1.844299	.1682233	.0536143	.0468526	40000	10.59663	13.50924
Powerdriven hand	3546	1.82868	.2975325	.0282886	.0322324	.	.	.
Prefabricated me	3448	1.802381	.1032271	.0467306	.057234	.	.	.
Prefabricated wo	2452	1.583333	.1605538	.0540219	.0555992	.	.	.
Prepared feeds,	2048	1.784314	.0057668	.0131007	.065931	.	.	.
Prepared flour m	2045	2.371429	.0800678	.0461495	.0591287	6072393	15.61926	13.60723
Prerecorded reco	3652	1.684211	.4156406	.0153687	.0270345	4255000	15.26361	13.08405
Pressed and blow	3229	1.951714	.262988	.1287402	.042623	1787650	14.15422	13.68729
Primary aluminum	3334	2.230769	.2423947	.0052002	.0368865	.	.	.

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Table A.2 – *Continued from previous page.*

Industry Name	SIC87	WIS	Import Pen.	Tariff	Pr. Tariff	Lobbying	ln(Lobbying)	Pr. ln(Lobbying)
Primary batterie	3692	1.83913	.1868493	.0556252	.049053	.	.	.
Primary copper	3331	2.421569	.2394777	.0077448	.0370261	4248500	15.24432	14.4172
Primary metal pr	3399	1.925541	.1753731	.0084209	.0443565	.	.	.
Primary nonferro	3339	2.527778	.7822894	.0034389	-.0134888	.	.	.
Printed circuit	3672	1.931177	.2561127	.0456047	.0364626	.	.	.
Printing ink	2893	2.099206	.117023	.0181326	.0517285	.	.	.
Printing trades	3555	1.857705	.3427852	.0313446	.0283496	1.42e+07	16.46455	13.83465
Process control	3823	2.042355	.2219163	.0494493	.0390243	.	.	.
Publishing, misc	2741	1.700574	.0952142	.0102958	.0689976	40000	10.59663	.
Pulp mills	2611	2.131349	.5598635	5.43e-07	.0144951	3513537	15.06237	13.41781
Pumps and pumpin	3561	1.699026	.1667566	.029094	.0460895	.	.	.
Radio TV commu	3663	1.79175	.1944856	.0413433	.0385445	6654956	15.70889	14.51541
Railroad equipme	3743	2.033584	.1966989	.0434122	.0400515	340000	12.73497	14.13833
Readymixed concr	3273	2.272727	.1819405	0	.0462007	.	.	.
Reconstituted wo	2493	1.87451	.2122561	.0442881	.0498447	.	.	.
Refrigeration an	3585	1.896082	.1436669	.0328672	.047368	.	.	.
Relays and indus	3625	1.895338	.1716262	.0486303	.044159	.	.	.
Rice milling	2044	2.574167	.101628	.0435017	.0674927	.	.	.
Robes and dressi	2384	1.568627	.3057622	.1311625	.0371718	.	.	.

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Table A.2 – *Continued from previous page.*

Industry Name	SIC87	WIS	Import Pen.	Tariff	Pr. Tariff	Lobbying	ln(Lobbying)	Pr. ln(Lobbying)
Rolling mill mac	3547	1.818005	.2661959	.0485081	.0366229	.	.	.
Rubber plastic	3052	1.756721	.1608159	.0472178	.0505551	.	.	.
Rubber and plast	3021	1.1875	.6439248	.226152	.0025051	.	.	.
Salted and roast	2068	1.846491	.1803491	.0136162	.0483618	40000	10.59663	13.36925
Sanitary food co	2656	1.547368	.1208942	.0380675	.0550615	.	.	.
Sanitary paper p	2676	2.191667	.068608	.0321933	.0588572	.	.	.
Sawmills and pla	2421	1.466667	.2885789	5.21e-06	.0424151	.	.	.
Scales balance	3596	1.5946	.244369	.0456959	.0399758	112000	11.62625	13.73998
Search and navig	3812	1.831743	.1635673	.0341817	.0291868	.	.	.
Secondary nonfer	3341	2.043651	.3561935	.0094766	.0280584	.	.	.
Semiconductors a	3674	1.806401	.4321189	.0212469	.00903	.	.	.
Service industry	3589	1.842997	.20294	.0326165	.0446838	.	.	.
Setup paperboard	2652	1.546296	.1164536	.051544	.0572605	.	.	.
Sheet metal work	3444	1.832378	.0938803	.0459401	.0550265	.	.	.
Signs and advert	3993	1.5007	.0908991	.0498013	.0562314	1674601	14.32557	13.07187
Silverware and p	3914	1.416667	.3001207	.0804619	.0325648	.	.	.
Small arms	3484	1.79191	.1890503	.0521794	.0418809	652500	13.36413	13.77608
Small arms ammun	3482	2.344393	.1325726	.0298216	.0501442	.	.	.
Soap and other d	2841	2.230952	.1040744	.0267524	.0549352	.	.	.

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Table A.2 – *Continued from previous page.*

Industry Name	SIC87	WIS	Import Pen.	Tariff	Pr. Tariff	Lobbying	ln(Lobbying)	Pr. ln(Lobbying)
Soft drinks, bot	2086	1.79881	.0567416	.0065974	.0816575	.	.	.
Softwood veneer	2436	2.083333	.1742954	.0297229	.0491365	.	.	.
Soybean oil mill	2075	2.368889	.1348617	.1433213	.0529978	0	.	.
Space propulsion	3764	1.60781	.1543787	.0132019	.0428759	180000	12.10071	14.36928
Special dies, to	3544	1.738401	.1722056	.0440089	.041205	.	.	.
Special industry	3559	1.927858	.2097243	.0365146	.0390871	.	.	.
Special product	2429	2.055556	.5352529	.0000995	.0071237	.	.	.
Speed changers,	3566	1.872602	.2650119	.0291398	.0363318	.	.	.
Sporting and ath	3949	1.641092	.3183542	.0572182	.0366806	.	.	.
Stationery produ	2678	1.821429	.1603605	.0347422	.0500545	.	.	.
Steel springs, e	3493	1.662588	.207719	.0258108	.041399	.	.	.
Steel wire and r	3315	2.28254	.2287216	.0333191	.0458443	.	.	.
Storage batterie	3691	2.277536	.1971063	.0494072	.0431269	.	.	.
Structural clay	3259	1.735294	.1399004	.0548094	.0645289	.	.	.
Structural wood	2439	2.159091	.2606607	.0473242	.0467988	.	.	.
Surface active a	2843	2.171383	.1370025	.0595271	.055638	.	.	.
Surgical and med	3841	2.003731	.1551271	.0836942	.0473686	.	.	.
Surgical applian	3842	1.807156	.1203838	.0476432	.0492585	.	.	.
Switchgear and s	3613	2.166667	.1682675	.049281	.0440367	.	.	.

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Table A.2 – *Continued from previous page.*

Industry Name	SIC87	WIS	Import Pen.	Tariff	Pr. Tariff	Lobbying	ln(Lobbying)	Pr. ln(Lobbying)
Synthetic rubber	2822	2.161698	.1972465	.01236	.0452637	.	.	.
Tanks and tank c	3795	1.668056	.2207214	.0032104	.0371037	2790000	14.84155	13.7472
Telephone and te	3661	2.055546	.2237796	.0432438	.0352763	.	.	.
Textile bags	2393	1.7322	.130854	.0851519	.0581296	.	.	.
Textile goods, N	2299	1.936956	.2982226	.0449424	.0433512	.	.	.
Textile machiner	3552	1.889072	.5480073	.0438612	.0091868	.	.	.
Thread mills	2284	2.06443	.1479682	.1299283	.0509278	1231875	14.01677	13.36659
Tire cord and fa	2296	2.031061	.1561769	.0793484	.0508252	.	.	.
Tires and inner	3011	1.639394	.2460473	.0379144	.0415853	.	.	.
Toilet preparati	2844	1.888889	.1391924	.0524086	.0505665	1235000	14.0097	13.38147
Transformers, ex	3612	1.673077	.2023283	.0366245	.0420757	.	.	.
Transportation e	3799	1.350681	.1049351	.0195513	.0552354	.	.	.
Travel trailers	3792	1.653846	.216806	.0182016	.0440511	.	.	.
Truck and bus bo	3713	1.823684	.3230387	.0213788	.0320686	405000	12.90973	13.71999
Truck trailers	3715	1.710526	.2358025	.0148215	.0397378	.	.	.
Turbines and tur	3511	1.830469	.2043841	.0479912	.0403357	.	.	.
Unsupported plas	3081	2.20942	.1365341	.050788	.0547691	.	.	.
Unsupported plas	3082	1.628386	.130189	.0518088	.0540776	140000	11.8494	13.96048
Valves and pipe	3494	1.994515	.1819516	.0540366	.0469195	.	.	.

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Table A.2 – *Continued from previous page.*

Industry Name	SIC87	WIS	Import Pen.	Tariff	Pr. Tariff	Lobbying	ln(Lobbying)	Pr. ln(Lobbying)
Vegetable oil mi	2076	1.91875	.3577961	.0114881	.0346712	.	.	.
Vehicular lighti	3647	1.979545	.1862714	.0403847	.0457143	1120787	13.91636	13.64083
Vitreous china f	3262	1.722222	.5479138	.1612313	.0168924	.	.	.
Vitreous plumbin	3261	1.673611	.1421624	.0910288	.0554203	.	.	.
Watches, clocks,	3873	2.5	.5550169	.0648329	.0113003	.	.	.
Waterproof outer	2385	1.685185	.6336292	.1085769	.0058117	0	.	.
Weft knit fabric	2257	1.971212	.1127842	.175253	.0577271	.	.	.
Welding apparatu	3548	1.701489	.2118284	.0313857	.0417039	.	.	.
Wet corn milling	2046	2.574603	.1223736	.0353712	.0676764	.	.	.
Wines, brandy, a	2084	2.083333	.38705	.0458682	.0322393	5401663	15.47506	13.96349
Women's & misses	2331	1.125	.3692412	.2094684	.0323819	.	.	.
Women's and chil	2341	1.447917	.2792613	.1448498	.0409585	.	.	.
Women's and miss	2339	1.646561	.345715	.1942494	.0354391	.	.	.
Women's and miss	2337	2.033333	.3628685	.1850979	.0340092	.	.	.
Women's footwear	3144	1.8	.620547	.1012294	.0078375	.	.	.
Women's handbags	3171	1.6	.7137099	.1348828	-.001583	20000	9.903487	13.78359
Women's, junior'	2335	1.5	.3844609	.1789846	.036046	.	.	.
Wood TV and radi	2517	1.666667	.074423	.0393563	.0606218	.	.	.
Wood containers,	2449	1.653922	.0771748	.0313309	.0585449	.	.	.

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Table A.2 – *Continued from previous page.*

Industry Name	SIC87	WIS	Import Pen.	Tariff	Pr. Tariff	Lobbying	ln(Lobbying)	Pr. ln(Lobbying)
Wood kitchen cab	2434	1.818182	.085869	.0346395	.0608252	.	.	.
Wood pallets and	2448	1.6	.1096054	.0461401	.0579306	.	.	.
Wood preserving	2491	2.078125	.1435367	.0411242	.0580338	.	.	.
Wood products, N	2499	1.851553	.1857555	.0521222	.0563344	0	.	.
Woodworking mach	3553	1.702041	.3060397	.0361839	.0339243	.	.	.
Xray apparatus a	3844	1.796091	.2980698	.026192	.030468	9374850	16.05147	13.71963
Yarn spinning mi	2281	1.924784	.1228073	.1030772	.0585706	.	.	.
Average		1.906238	.214222	.0498076	.0449182	3391869	13.62012	13.66228

A.2 Figures

Annual box plots for both the standard Grubel-Lloyed index and the "unwrapped" version are reported in Figure A.1 and Figure A.2 respectively. The pattern in Figure A.1 suggests that since 1976, the average level of intra-industry trade has actually been on a decline in the United States. In Figure A.2 we can see that intra-industry trade has been declining due to an increase in imports as a share of trade (448 4-digit SIC industries, over 34 years). This increase in imports in the trade balance matches other observations in the literature (Baldwin 2011). Additionally, these box plots highlight only the economy wide averages, and not individual industry levels of intra-industry trade.

Figure A.1: Grubel-Lloyed Index

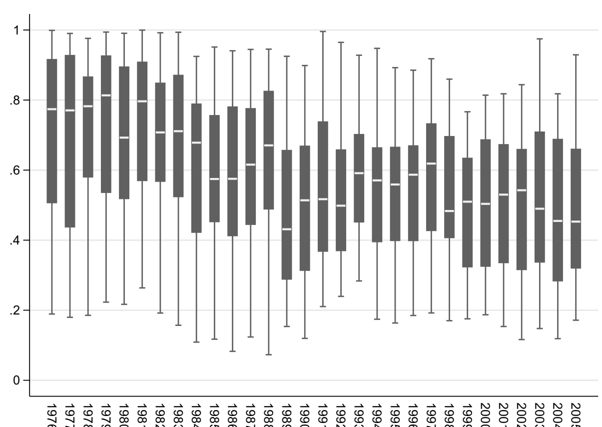

Figure A.2: Modified Grubel-Lloyed Index